SOIL SURVEY

Cherokee and Delaware Counties Oklahoma

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
OKLAHOMA AGRICULTURAL EXPERIMENT STATION

Issued December 1970

Major fieldwork for this soil survey was done in the period 1958–66. Soil names and descriptions were approved in 1967. Unless otherwise indicated, statements in this publication refer to conditions in the county in 1967. This survey was made cooperatively by the Soil Conservation Service and the Oklahoma Agricultural Experiment Station. It is part of the technical assistance furnished to the Cherokee County and the Delaware County Soil and Water Conservation Districts.

Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, USDA, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms, ranches, and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for agriculture, industry, and recreation.

Locating Soils

All the soils of Cherokee and Delaware Counties are shown on the map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page for the woodland group and range site in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the capability units, range sites, and woodland groups.

Foresters and others can refer to the section "Use of Soils as Woodland," where the soils of the county are grouped according to their suitability for trees.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Wildlife and Fish."

Ranchers and others can find, under "Management of Range," groupings of the soils according to their suitability for range, and also the names of many of the plants that grow on each range site.

Community planners and others can read about soil properties that affect the choice of sites for recreation areas in the section "Use of Soils as Recreational Sites."

Engineers and builders can find, under "Engineering Uses of Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of Soils."

Newcomers in the survey area may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the area given at the beginning of the publication.

Cover picture: Tenkiller Lake, located in the Hector-Linker soil association, provides excellent recreation potential.

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SOIL SURVEY OF CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA

BY EVERETT L. COLE, SOIL CONSERVATION SERVICE

SOILS SURVEYED IN CHEROKEE COUNTY BY PETER WARTH AND DOCK J. POLONE, AND IN DELAWARE COUNTY BY EVERETT L. COLE AND JOSEPH A. ICENHOWER, ALL OF THE SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE IN COOPERATION WITH THE OKLAHOMA AGRICULTURAL EXPERIMENT STATION

CHEROKEE AND DELAWARE Counties are in the northeastern part of Oklahoma (fig. 1). Delaware County lies along the eastern boundary of the State and is north of Cherokee County.

Cherokee County has a land area of about 483,840 acres, or 756 square miles. Tahlequah, the county seat, is in the central part of the county. The main source of income in the county is the sale of livestock and livestock products. Small grains, corn, grain sorghum, and improved grasses and legumes for hay are grown as feed for livestock. Pasture grasses and native grasses in woodland are grazed by livestock. The sale of timber supplements the farm income. Woodland occupies about 61 percent of Cherokee County.

Delaware County has a land area of about 457,600 acres, or 715 square miles. Jay, the county seat, is in the central part of the county. Its elevation is about 1,032 feet. The county lies within two physiographic regions, the Cherokee Prairies and the Ozark Highland. The northern one-third of the county is mostly prairie. Here farming is based mainly on raising livestock and growing grain. The soils are used mostly for pasture, grain, and hay. The southern part of the county, much of it rugged, is part of the Ozark Highland. The soils in the southern part are well suited to trees. About 56 percent of the county is woodland. These soils are used mostly for grazing and timber. The sale of forest products supplements farm income. The more nearly level soils have been mostly cleared of trees and are used for tame pasture, field crops, and native grasses.

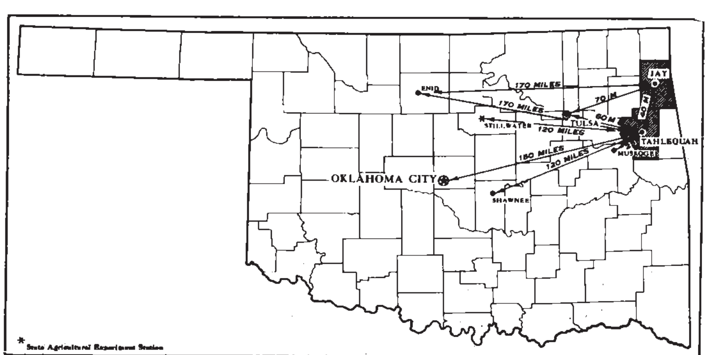

***Figure 1.*—Location of Cherokee and Delaware Counties in Oklahoma.**

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soils are in Cherokee and Delaware Counties, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. As they traveled over the county, they observed the steepness, length, and shape of slopes; the size and speed of streams; the kinds of native plants or crops; the kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The soil series and the soil phase are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Baxter and Clarksville, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Clarksville stony silt loam, 5 to 20 percent

slopes, is one of several phases within the Clarksville series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map in the back of this publication was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Two such kinds of mapping units are shown on the soil map of Cherokee and Delaware Counties: soil complexes and soil associations and undifferentiated groups.

A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Baxter-Locust complex, 3 to 5 percent slopes, is an example.

A soil association is made up of adjacent soils that occur as areas large enough to be shown individually on the soil map but are shown as one unit because the time and effort of delineating them separately cannot be justified. There is a considerable degree of uniformity in pattern and relative extent of the dominant soils, but the soils may differ greatly one from another. The name of an association consists of the names of the dominant soils, joined by a hyphen. Hector-Linker association, hilly, is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. Elsah soils is an example. This group consists of two or more Elsah soils that have surface layers of different texture.

In most areas surveyed there are places where the soil material is so stony, so shallow, or so severely eroded that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Rough stony land is a land type in Cherokee and Delaware Counties.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soils in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soils. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users; among them farmers, managers of woodland and rangeland, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others, then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map in a pocket at the back of this survey shows, in color, the soil associations in Cherokee and Delaware Counties. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of farming or other land use. Such a map is not suitable for planning the management of a farm or field, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect management.

The six soil associations in Cherokee and Delaware Counties are described in the pages that follow.

1. Sallisaw-Elsah-Staser Association

Deep, gravelly or loamy, nearly level to sloping soils on flood plains and benches

This association is made up of nearly level to sloping soils on flood plains and benches along major streams in the two counties. These soils formed under trees and native grasses in loamy alluvial deposits. This association occupies about 10 percent of Cherokee County and about 11 percent of Delaware County. Figure 2 shows the topographic position of the major soils in this association.

Sallisaw soils occupy about 41 percent of this association; Elsah soils, about 16 percent; Staser soils, about 37 percent; and minor soils the remaining 6 percent. Among the minor soils are the Osage, Stigler, and Verdigris.

The Sallisaw soils are nearly level to sloping and occur on benches along the major streams. These soils have a surface layer of dark-brown gravelly silt loam and a subsoil of strong-brown gravelly silty clay loam.

The Elsah soils are nearly level, occur on flood plains, and are frequently flooded. They have a surface layer of dark-brown very gravelly loam. The subsoil is dark grayish-brown very gravelly loam that is 60 to 90 percent gravel, by volume. Elsah soils occur mainly in Cherokee County.

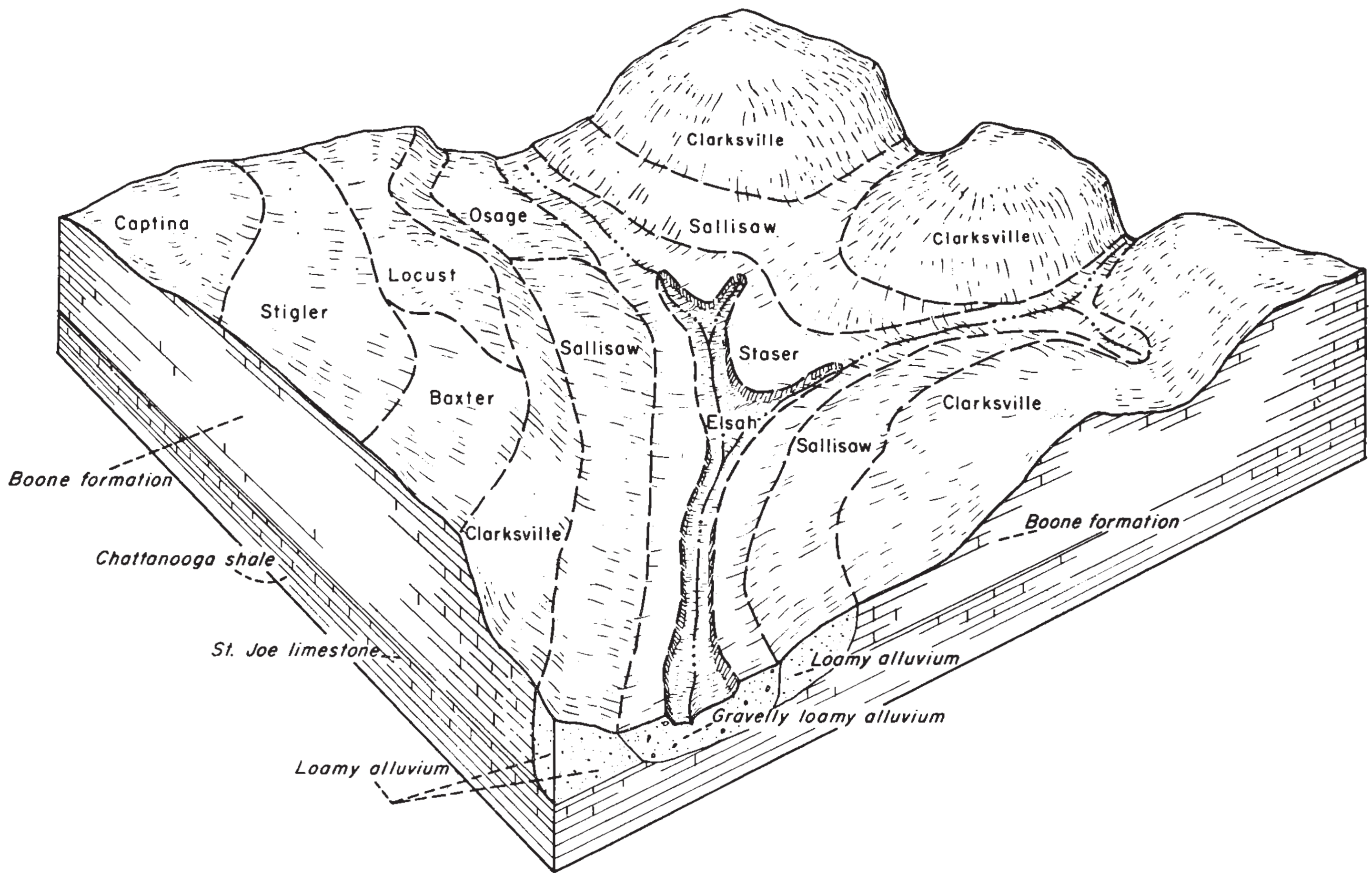

Figure 2.—**Major soils in soil associations 1 and 3 and their relation to the landscape. Soil association 1 is near the middle of the figure, and soil association 3 is to the left.**

The Staser soils are nearly level to very gently sloping and occur on flood plains. These soils are subject to occasional flooding. They have a very dark grayish-brown gravelly loam surface layer. The subsoil is dark-brown gravelly loam that is 15 to 35 percent gravel, by volume.

Most of the acreage of Sallisaw and Staser soils has been cleared of timber and is used for tame pasture and cultivated crops. Under good management these soils are well suited to small grains, sorghums, beans, corn, and other adapted crops. In some areas the Sallisaw and Staser soils are irrigated. The proper use of crop residue and fertilizers helps to maintain good soil structure and fertility. The native vegetation consists mostly of oak elm, hickory, walnut, maple, and sycamore. Elsah soils occupy most of the acreage remaining in timber. Some of the best trees in the two counties grow on the soils of this association.

2. Eldorado-Newtonia-Okemah Association

Deep, loamy, nearly level to strongly sloping soils on prairie uplands

This association consists of nearly level to strongly sloping soils on the prairie uplands of the two counties. These soils developed from loamy and clayey material in limestone and sandstone areas where the native vegetation was grasses. This association makes up almost 10 percent of Cherokee County and about 14 percent of Delaware County. Figure 3 shows the topographic position of the major soils.

Eldorado soils make up about 30 percent of this association; Newtonia soils, about 16 percent; Okemah soils, about 14 percent; and Dennis soils, about 8 percent. The remaining 32 percent consists of Bates, Choteau, Collinsville, Jay, Parsons, Taloka, Summit, and Woodson soils.

The very gently sloping to strongly sloping Eldorado soils occur on the ridgetops and slopes. They have a surface layer of very dark grayish-brown cherty silt loam and a subsoil of dark-brown very cherty silty clay loam. These soils formed in weathered cherty limestone of the Boone formation.

The Newtonia and Okemah soils are nearly level to gently sloping. The Newtonia soils have a thick dark reddish-brown silt loam surface layer that grades to a reddish-brown silty clay loam subsoil. The Okemah soils have a black silty clay loam surface layer and an olive-brown silty clay loam subsoil that is mottled with gray in the lower part.

The Dennis soils are very gently sloping. Their surface layer is very dark grayish-brown silt loam, and their subsoil is dark yellowish brown silty clay loam.

Most of this association is used for crops and tame pasture. Small grains and sorghums are the main crops.

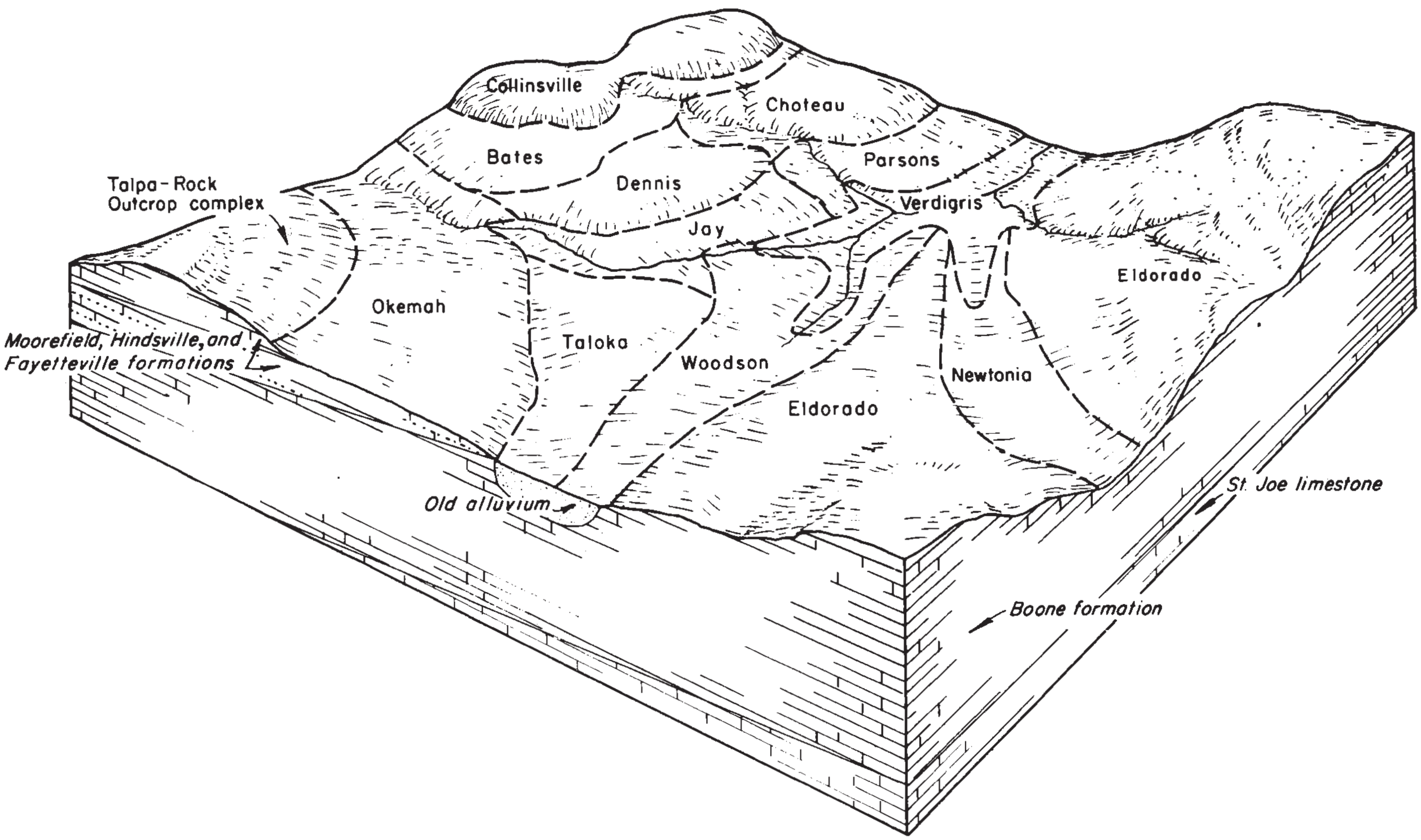

Figure 3.—Major soils in soil association 2 and their relation to the landscape.

The soils are well suited to crops and pasture but are susceptible to water erosion. Managing crop residue, planting cover crops, building terraces, and adding fertilizer are practices that help to maintain structure and fertility.

About 20 percent of this association is used for range. When management is good and grazing is regulated, forage plants grow well. The vegetation consists mostly of little bluestem, big bluestem, indiangrass, and switchgrass.

3. Clarksville-Baxter-Locust Association

Deep, stony and cherty, very gently sloping to steep soils on timbered uplands

This association consists of very gently sloping to steep soils that occupy narrow areas between numerous streams (fig. 4). These soils formed under trees in the cherty limestone areas of the two counties. They make up 41 percent of Cherokee County and 59 percent of Delaware County. Figure 2 shows the position of the major soils in the association.

The Clarksville soils occupy about 91 percent of this association, and the Baxter and Locust soils together, about 9 percent.

The Clarksville soils range from very gently sloping to steep but are steep in most places. They have a surface layer of dark grayish-brown stony silt loam and a subsoil of strong-brown very stony silty clay loam.

The Baxter and Locust soils occur in higher positions than the Clarksville soils and are very gently sloping to gently sloping. The Baxter soils have a cherty silt loam surface layer that is dark grayish brown in the upper part and lighter colored in the lower part. The subsoil is yellowish-red cherty silty clay loam. The Locust soils also have a cherty silt loam surface layer that is dark grayish brown in the upper part, but it grades to brown in the lower part. The subsoil is yellowish-brown cherty silty clay loam.

About 60 percent of this association is used for trees and grass. Most areas provide fair grazing for cattle, though some areas support very little grass. The native vegetation consists mostly of hardwoods and an understory of big bluestem, little bluestem, indiangrass, and purpletop. The rest of this association is used mainly for tame pasture and for small grains and grain sorghum. The crops are grown mostly on the Baxter and Locust soils.

4. Baxter-Locust Association

Deep, cherty and loamy, nearly level to gently sloping soils on timbered uplands

This association consists of nearly level to gently sloping soils on broad divides between entrenched streams. These soils developed in the cherty limestone area under native trees and grasses. They make up about 14 percent of Delaware County and about 8 percent of Cherokee County.

Of this association, about 47 percent is Baxter soils, 28 percent is Locust soils, 17 percent is Captina soils, and the rest is Stigler soils. The Baxter soils occur only in Delaware County.

***Figure 4.*—Typical relief of association 3 showing Clarksville stony silt loam in the foreground and background. Staser gravelly loam is in the drainageway in the middle ground.**

The Baxter and Locust soils are very gently to gently sloping. The Baxter soils have a cherty silt loam surface layer that is dark grayish brown in the upper part and lighter colored in the lower part. The subsoil is yellowish-red cherty silty clay loam that increases in content of chert with increasing depth.

The Locust soils have a surface layer similar to that of the Baxter soils. The subsoil of Locust soils is less clayey and more brownish than that of the Baxter soils.

The Captina soils are very gently sloping and occur closely with the more cherty Baxter and Locust soils. Captina soils have a dark grayish-brown or grayish-brown silt loam surface layer. The subsoil is dark yellowish-brown silty clay loam that has a fragipan at a depth of about 27 inches.

The Stigler soils are nearly level and occur in slightly lower positions than the other soils of this association. They have a dark grayish-brown silt loam surface layer and a pale-brown silty clay loam subsoil.

About 80 percent of this association is used for tame pasture and crops. If the soils are cultivated, the main practices needed are those that dispose of excess water during the short periods of wetness, that improve water intake at other times, and that maintain soil structure and fertility. The use of crop residue, cover crops, and fertilizer is beneficial. In the more sloping areas contour tillage and terraces are also needed. The part of this association not cultivated has a cover of hardwoods and an understory of big bluestem, little bluestem, and indiangrass. Most areas in trees or grass are producing considerably below their potential capacity.

5. Hector-Linker Association

Very shallow to deep, stony and loamy, gently sloping to steep soils on uplands

This association consists of gently sloping to steep soils that descend from ridges into deep valleys about 100 to 400 feet below the crest of the ridges. Most of the area is rugged, and there are a few flat-topped mountains and rocky cliffs. The soils were derived from sandstone and some limestone and shale. They occur mostly in the southern and west-central parts of Cherokee County and in one small area in the southeastern part of Delaware County. This association makes up about 31 percent of Cherokee County and about 1 percent of Delaware County. Figure 5 shows the topographic position of the major soils in this association.

Of this association, about 45 percent is Hector soils,

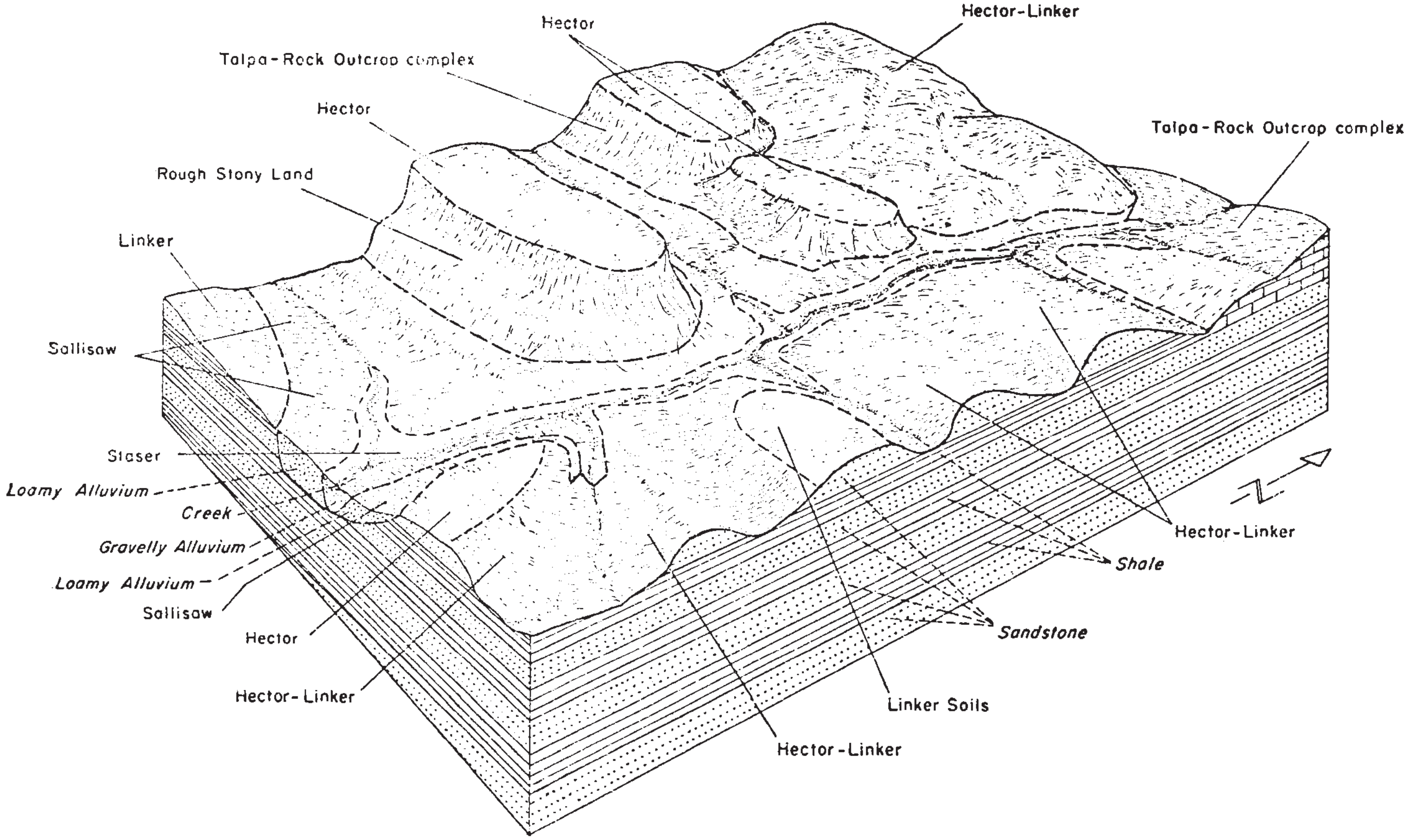

***Figure 5.*—Major soils in soil association 5 and their relation to the landscape. The soils in this association are on both sides of the Sallisaw and Staser soils, which are in soil association 1.**

about 35 percent is Linker soils, and the rest is minor soils and land types.

The Hector soils are very shallow or shallow over sandstone. They have a dark-brown fine sandy loam surface layer that is stony in many places. The subsoil is similar to the surface layer in texture but is slightly browner.

The Linker soils are moderately deep to deep over sandstone. They have a dark-brown fine sandy loam surface layer and a yellowish-red clay loam subsoil.

The minor soils and land types are the Talpa soils and Rough stony land. The Talpa soils are closely intermingled with outcrops of rock on brushy prairie uplands. The very gently sloping to steep Talpa soils are very dark brown silty clay loams that are very shallow or shallow over limestone. In Rough stony land are shallow to very shallow, very steep soils among rock outcrops, ledges, and cliffs.

About 70 percent of this association is woodland and grassland. Except on the Linker soils, trees do not grow well. The soils in this association are suited to grass except in areas of thick brush. The native vegetation consists mostly of hardwoods of low quality and an understory of big bluestem, little bluestem, indiangrass, and purpletop. The rest of this association is mainly in tame pastures on which control of brush is often necessary. Field crops are grown mostly on the Linker soils. Good management of crop residue and use of terraces are ways to help control erosion on these soils.

6. Parsons-Dennis Association

Deep, loamy, nearly level to very gently sloping soils that have a clayey or loamy subsoil; on prairie uplands

This association consists of nearly level or very gently sloping soils on prairie uplands that are dissected in places by V-shaped sloping drainageways. These soils are in the northwestern part of Delaware County. They formed under tall prairie grasses in loamy to clayey material that was derived from shale and sandstone of Pennsylvanian age. This association covers about 1 percent of Delaware County, but does not occur in Cherokee County.

Parsons soils make up about 40 percent of this association; Dennis soils, about 35 percent; and minor soils, the rest.

The Parsons soils are nearly level to slightly depressional. They have a very dark grayish-brown silt loam surface layer that has an abrupt boundary at a depth of about 12 inches. It is underlain by a very slowly permeable clayey subsoil. The subsoil is a mottled dark grayish-brown to brown clay. Parsons soils are somewhat poorly drained but tend to be droughty in summer.

The Dennis soils are very gently sloping and occur with the nearly level Parsons soils. Dennis soils are well drained. Their surface layer consists of very dark grayish-brown silt loam about 13 inches thick. The subsoil is slowly permeable silty clay loam that has high available moisture capacity.

The minor soils are the Okemah, Bates, and Eldorado. The Okemah soils are deep and clayey and have a mottled subsoil. Bates soils are moderately deep over sandstone, and the Eldorado soils have a very cherty subsoil.

Much of this association is cultivated. Small grains, largely wheat, and grain sorghum, soybeans, and corn are grown. Tame pasture is important. These soils are medium to high in fertility, but in most places they respond well to a complete fertilizer. In many places the nearly level Parsons soils need surface drainage to remove excess water. The Dennis soils are susceptible to water erosion. The use of crop residue, cover crops, and terraces helps to maintain soil structure and fertility.

Descriptions of the Soils

In this section the soil series and mapping units in each series are described. The acreage and proportionate extent of each mapping unit are given in table 1.

The procedure is first to describe the soil series, and then the mapping units in that series. Thus, to get full information on any one mapping unit, it is necessary to read the description of that unit and also the description of the series to which it belongs. The description of a soil series mentions features that apply to all the soils in a series. Differences among the soils of one series are pointed out in the description of the individual soils or are indi-

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Cherokee County		Delaware County		Total	
	Acres	Percent	Acres	Percent	Acres	Percent
Bates loam, 1 to 3 percent slopes			4, 334	0. 9	4, 334	0. 5
Baxter silt loam, 1 to 3 percent slopes			25, 200	5. 5	25, 200	2. 7
Baxter cherty silt loam, 1 to 3 percent slopes			10, 120	2. 2	10, 120	1. 1
Baxter-Locust complex, 3 to 5 percent slopes			15, 580	3. 4	15, 580	1. 7
Captina silt loam, 1 to 3 percent slopes	9, 945	2. 1	9, 490	2. 1	19, 435	2. 1
Choteau silt loam, 0 to 1 percent slopes			940	. 2	940	(1)
Choteau silt loam, 1 to 3 percent slopes			1, 400	. 3	1, 400	. 1
Clarksville very cherty silt loam, 1 to 8 percent slopes	25, 055	5. 2	55, 570	12. 1	80, 625	8. 6
Clarksville stony silt loam, 5 to 20 percent slopes	93, 825	19. 4	114, 958	25. 1	208, 783	22. 2
Clarksville stony silt loam, 20 to 50 percent slopes	67, 382	13. 9	72, 670	15. 9	140, 052	14. 9
Collinsville fine sandy loam, 2 to 5 percent slopes	1, 186	. 2	716	. 2	1, 902	. 2
Dennis silt loam, 1 to 3 percent slopes	806	. 2	9, 948	2. 2	10, 754	1. 1
Eldorado silt loam, 1 to 3 percent slopes			13, 250	3. 0	13, 250	1. 4
Eldorado silt loam, 3 to 5 percent slopes	4, 139	. 9	5, 820	1. 3	9, 959	1. 1
Eldorado soils, 3 to 12 percent slopes	1, 481	. 3	7, 740	1. 7	9, 221	1. 0
Elsah soils	15, 689	3. 2	1, 200	. 3	16, 889	1. 8
Hector fine sandy loam, 2 to 5 percent slopes	27, 722	5. 7	200	(1)	27, 922	3. 0
Hector-Linker association, hilly	91, 765	19. 0	200	(1)	91, 965	9. 8
Jay silt loam, 0 to 2 percent slopes	5, 212	1. 1	2, 880	. 6	8, 092	. 8
Linker fine sandy loam, 2 to 5 percent slopes	7, 236	1. 5			7, 236	. 8
Locust cherty silt loam, 1 to 3 percent slopes	26, 055	5. 4	8, 195	1. 8	34, 250	3. 6
Newtonia silt loam, 0 to 1 percent slopes			2, 920	. 6	2, 920	. 3
Newtonia silt loam, 1 to 3 percent slopes	6, 648	1. 4	3, 780	. 8	10, 428	1. 1
Newtonia silt loam, 3 to 5 percent slopes	2, 463	. 5	74	(1)	2, 537	. 3
Newtonia silt loam, 2 to 5 percent slopes, eroded	584	. 1			584	(1)
Okemah silt loam, 0 to 1 percent slopes			1, 080	. 2	1, 080	. 1
Okemah silty clay loam, 0 to 1 percent slopes	3, 343	. 7	100	(1)	3, 443	. 4
Okemah silty clay loam, 1 to 3 percent slopes	7, 539	1. 5	1, 440	. 3	8, 979	. 9
Okemah silty clay loam, 3 to 5 percent slopes	2, 699	. 5			2, 699	. 3
Osage clay	1, 795	. 4			1, 795	. 2
Parsons silt loam, 0 to 1 percent slopes			2, 475	. 5	2, 475	. 3
Rough stony land	8, 096	1. 7			8, 096	. 8
Sallisaw silt loam, 0 to 1 percent slopes	1, 156	. 2	340	(1)	1, 496	. 1
Sallisaw silt loam, 1 to 3 percent slopes	3, 310	. 7	5, 950	1. 3	9, 260	1. 0
Sallisaw gravelly silt loam, 1 to 3 percent slopes	12, 298	2. 6	4, 090	. 9	16, 388	1. 7
Sallisaw gravelly silt loam, 3 to 8 percent slopes	11, 924	2. 4	13, 320	3. 0	25, 244	2. 7
Staser silt loam	4, 224	. 9	3, 240	. 7	7, 464	. 8
Staser gravelly loam	4, 513	. 9	35, 020	7. 7	39, 533	4. 2
Stigler silt loam, 0 to 1 percent slopes	3, 854	. 8	7, 300	1. 6	11, 154	1. 2
Summit silty clay loam, 2 to 5 percent slopes, eroded	1, 432	. 3			1, 432	. 1
Taloka silt loam, 0 to 1 percent slopes	938	. 2	6, 960	1. 5	7, 898	. 8
Talpa-Rock outcrop complex, 2 to 8 percent slopes	5, 566	1. 1	660	. 1	6, 226	. 7
Talpa-Rock outcrop complex, 15 to 50 percent slopes	23, 148	4. 8			23, 148	2. 4
Verdigris silt loam	812	. 2	2, 380	. 5	3, 192	. 3
Verdigris soils, frequently flooded			1, 480	. 3	1, 480	. 1
Woodson silt loam, 0 to 1 percent slopes			4, 580	1. 0	4, 580	. 5
Total	483, 840	100. 0	457, 600	100. 0	941, 440	100. 0

[1] Less than 0.1 percent.

cated in the soil name. As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Rough stony land, for example, is a miscellaneous land type that does not belong to a soil series. It is listed, nevertheless, in alphabetic order along with the soil series.

Each series contains a short description of a typical soil profile and a more detailed description of the same profile that scientists, engineers, and others can use in making highly technical interpretations. The colors given are for moist soils unless otherwise specified. Some of the terms used to describe the soils are defined in the Glossary at the back of this soil survey. Others are defined in the "Soil Survey Manual" (*5*).[1]

Bates Series

The Bates series consists of moderately deep to deep, very gently sloping soils that have a medium-textured surface layer and a moderately fine or medium-textured subsoil. These soils developed in material weathered from sandstone on uplands in the northern part of Delaware County. The native vegetation is mainly big bluestem and little bluestem.

In a typical profile the surface layer is very dark grayish-brown loam about 12 inches thick. It is very friable when moist and is slightly acid. The yellowish-brown subsoil extends to a depth of about 30 inches, is hard when dry and friable when moist, and is strongly acid. It is loam to a depth of about 20 inches and clay loam below. Sandstone is at a depth of about 30 inches.

These soils are moderately permeable and well drained. They are medium in fertility, have fair available moisture capacity, and are moderately well suited to crops.

These soils are used mostly for cultivated crops or tame pasture.

Profile typical of a Bates loam, 660 feet west and 80 feet south of the northeast corner of section 7, T. 24 N., R. 25 E.:

A1—0 to 12 inches, very dark grayish-brown (10YR 3/2) loam, grayish brown (10YR 5/2) when dry; moderate, fine, granular structure; slightly hard, very friable; slightly acid; gradual, smooth boundary; horizon 10 to 14 inches thick.

B1—12 to 20 inches, yellowish-brown (10YR 5/4) heavy loam, light yellowish brown (10YR 6/4) when dry; weak, fine, subangular blocky structure; hard, friable; sand grains coated with clay films; a few, fine, prominent, red spots that are slightly hard; medium acid; gradual, smooth boundary; horizon 6 to 15 inches thick.

B2t—20 to 30 inches, yellowish-brown (10YR 5/4) light clay loam, light yellowish brown (10YR 6/4) when dry; weak, medium, subangular blocky structure; hard, friable; a few clay films; common, medium, prominent, slightly hard, red spots; a few, small, weathered fragments of red sandstone; strongly acid; clear, smooth boundary; horizon 6 to 20 inches thick.

R—30 inches +, yellowish-brown sandstone.

Color of the A horizon has a hue of 7.5YR or 10YR, value of less than 3.5, and chroma of 2 or 3. This horizon generally is 12 to 22 percent clay, but in some places the texture is fine sandy loam.

Color of the B2t horizon has a hue of 10YR or 7.5 YR, value of 4 or 5, and chroma ranging from 4 to 6. The texture ranges from loam to sandy clay loam; the content of clay is 24 to 35 percent. Depth to the R horizon ranges from 20 to 40 inches.

The Bates soils have less clayey A1 and B2t horizons than the Dennis and Okemah soils. The cherty characteristic of Eldorado soils is missing in the Bates soils.

Bates loam, 1 to 3 percent slopes (BaB).—This moderately deep soil occupies prairie uplands in sandstone areas of Delaware County. The profile is the one described as typical for the series.

Included with this soil in mapping are areas of Dennis silt loam in slightly lower positions, of Collinsville fine sandy loam in higher positions, and of similar soils in which depth to sandstone is slightly more than 40 inches. These included areas make up about 25 percent of the area mapped. Also included are small eroded areas.

Wheat, grain sorghum, corn, soybeans, and tame pastures are the main crops grown on this soil. A small acreage is in native grass range.

Water erosion occurs unless this soil is protected by terraces, waterways, and crop residue. Adding fertilizer increases the crop residue and helps to improve tilth, soil structure, and natural fertility. (Capability unit IIe-1; Loamy Prairie range site; woodland suitability group, none)

Baxter Series

The Baxter series consists of deep, very gently sloping to gently sloping soils that have a cherty or a medium-textured surface layer and a cherty subsoil. These soils developed in material weathered from cherty limestone on uplands in the southern two-thirds of Delaware County. The native vegetation consists mainly of oak, hickory, elm, hackberry, and shortleaf pine and an understory that is mostly big bluestem and little bluestem.

In a typical profile the surface layer is dark grayish-brown, strongly acid cherty silt loam about 9 inches thick. It is very friable when moist. The subsoil extends to a depth of 60 inches and is very strongly acid. It is reddish-brown and yellowish-red, friable cherty silty clay loam to a depth of 22 inches and is red, firm cherty and very cherty clay below that depth. Below a depth of 34 inches the subsoil is mottled with yellowish red and gray and is 50 percent chert fragments.

These soils are well drained and moderately slow in permeability. They have medium fertility. Available moisture capacity is fair to good.

Most of the acreage of these soils is in tame pasture, range, and cultivated crops.

Typical profile of Baxter cherty silt loam, about 2,400 feet south and 50 feet east of the northwest corner of section 14, T. 20 N., R. 23 E.:

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) cherty silt loam, light brownish gray (10YR 6/2) when dry; weak, fine, granular structure; slightly hard, very friable; strongly acid; clear, smooth boundary; horizon 6 to 18 inches thick.

B1—9 to 14 inches, reddish-brown (5YR 4/4) cherty silty clay loam, reddish brown (5YR 5/4) when dry; moderate, medium, subangular blocky structure; hard, friable; very strongly acid; gradual, smooth boundary; horizon 4 to 10 inches thick.

B21t—14 to 22 inches, yellowish-red (5YR 4/6) heavy cherty silty clay loam, yellowish red (5YR 5/6) when dry; moderate, medium, subangular blocky structure; hard, friable; clay films; very strongly acid; gradual, smooth boundary; horizon 4 to 16 inches thick.

[1] Italic numbers in parentheses refer to Literature Cited, p. 73.

B22t—22 to 34 inches, red (2.5YR 4/6) cherty clay, red (2.5YR 5/6) when dry; moderate, medium, angular blocky structure; very hard, firm; clay films; very strongly acid; gradual, smooth boundary; horizon 6 to 20 inches thick.

B3—34 to 60 inches, red (2.5YR 4/6) very cherty clay, red (2.5YR 5/6) when dry; coarse to medium, faint, yellowish-red (5YR 5/6 moist) and coarse, prominent, gray (10YR 6/1 moist) mottles; moderate, medium, blocky structure; very hard, firm; clay films on ped surfaces; chert fragments are about 50 percent of volume; very strongly acid.

Colors of the Ap horizon are 10YR or 7.5YR in hue, 4 to 5 in value, and 2 to 4 in chroma. In forested areas the A1 horizon is very dark grayish brown and ranges from 1 to 3 inches in thickness. In these areas the A2 horizon is 10YR or 7.5YR in hue, 5 or 6 in value, and 2 to 4 in chroma. The texture of the A horizons ranges from cherty silt loam to silt loam; the content of chert ranges from 0 to 30 percent.

The B1 horizon ranges from 2.5YR to 10YR in hue, from 4 to 5 in value, and from 3 to 6 in chroma. Texture ranges from silty clay loam to cherty silty clay loam that is 28 to 37 percent clay and 5 to 35 percent chert. The B2t horizon is 2.5YR or 5YR in hue, 4 or 5 in value, and 4 to 8 in chroma. Texture ranges from heavy cherty silty clay loam to cherty clay that is 35 to 50 percent clay, 10 to 35 percent chert, and more than 15 percent material coarser than very fine sand. Reaction of the B2t horizon ranges from very strongly acid to strongly acid. The B3 horizon has colors similar to those in the B2t horizon, and the content of chert in the B3 horizon is more than 35 percent.

The Baxter soils have less cherty A and B2t horizons than the Clarksville soils. The B2t horizon is more clayey in the Baxter soils than it is in the Clarksville, Captina, and Sallisaw soils. Baxter soils lack the fragipan characteristic of the Captina soils and the dark, thick A1 horizon characteristic of the Newtonia soils.

Baxter cherty silt loam, 1 to 3 percent slopes (BhB).—This is a deep soil that formed under trees on uplands in the cherty limestone areas of the county. The profile is the one described as typical for the series.

Included with this soil in the mapping are areas of Locust cherty silt loam, totaling less than 10 percent of the acreage mapped, and of Baxter silt loam, totaling less than 4 percent. In cultivated fields a few small areas are eroded.

Because this soil is difficult to till, it is used mostly for tame pastures of bermudagrass and clovers. Also grown are orchard trees, strawberries, small grains, sorghums, and vegetables. A small acreage is in hardwoods and pine. Crops normally do not grow well, because the high content of chert reduces the available moisture.

On this moderately fertile soil, residue of cultivated crops can be increased by additions of fertilizer. The residue helps to control erosion and to maintain soil structure and fertility. In areas where this soil is eroding, terraces and waterways are needed to divert the runoff water. (Capability unit IIIs–1; Smooth Chert Savannah range site; woodland suitability group 3)

Baxter-Locust complex, 3 to 5 percent slopes (BlC).—This complex consists of deep, loamy soils formed under trees on uplands in the cherty limestone areas of Delaware County. Baxter soils make up about 50 percent of the complex, and Locust soils, about 35 percent.

The Baxter soil has a thin, dark grayish-brown, cherty silt loam surface layer that is underlain by a slightly lighter colored horizon about 6 inches thick. The subsoil is cherty silty clay loam that is strong brown in the upper part and grades to yellowish red at a depth of 31 inches. The percentage of chert increases with increasing depth.

The Locust soil has a thin, grayish-brown cherty silt loam surface layer that is underlain by a slightly lighter colored subsurface layer. The subsoil is strong-brown cherty silty clay loam that is about 40 percent chert. The subsoil is mottled with grayish colors at a depth of 26 inches.

This soil complex is used for woodland, native grass, tame pastures, and field crops. The soils are difficult to till and, where they are cultivated, a large amount of residue needs to be returned to their surface layer to help improve fertility. Tame pastures generally require mowing to prevent sprouts from shading out the grass (fig. 6). In wooded areas, weeding, thinning, and proper harvesting are needed for the best growth of the trees. (Capability unit IVs–1; Smooth Chert Savannah range site; woodland suitability group 3)

Baxter silt loam, 1 to 3 percent slopes (BcB).—This is a deep soil that formed under trees on uplands in the cherty limestone areas of the county. Except for having a lower content of chert, this soil has a profile similar to the one described as typical for the series. The surface layer is dark yellowish-brown silt loam. The subsoil layers are silty clay loams that are 10 to 35 percent chert, by volume. These layers grade to red, yellowish brown, and gray at a depth of about 34 inches.

Included with this soil in mapping are areas of Baxter cherty silt loam, totaling less than 12 percent of the acreage mapped, and of Captina silt loam, totaling less than 8 percent. Also included are areas of soil having a thin, eroded surface layer.

Baxter silt loam, 1 to 3 percent slopes, is mainly used for tame pastures and small grains. Soybeans, sorghums, vegetables, and orchard trees are also grown. If this soil is managed well, hardwoods, pine, and native grasses grow well.

Figure 6.—**Bermudagrass, fescuegrass, and legumes produce nearly year-round grazing on this Baxter-Locust complex, 3 to 5 percent slopes.**

Because this soil is subject to erosion in cultivated areas, additions of fertilizer are beneficial in increasing the amount of crop residue and reducing loss of soil. The crop residue also increases the content of organic matter and helps to maintain soil structure and fertility. Terraces, contour farming, and waterways are commonly used to help control erosion on long slopes where it is most intense. (Capability unit IIe-2; Smooth Chert Savannah range site; woodland suitability group 2)

Captina Series

The Captina series consists of very gently sloping soils that have a medium-textured surface layer over a moderately fine textured subsoil. These soils developed in material weathered from cherty limestone on timbered uplands. The native vegetation is mainly oak, hickory, hackberry, elm, and shortleaf pine and an understory consisting mostly of big bluestem and little bluestem.

In a typical profile the surface layer, about 7 inches thick, is silt loam that is dark grayish brown in the upper 2 inches and grayish brown below. It is very friable and strongly acid. The subsoil extends to a depth of 50 inches and consists of silty clay loam that is yellowish brown and dark yellowish brown to a depth of 23 inches and is mottled yellowish brown, dark yellowish brown, gray, and yellowish red below. A fragipan has formed in the subsoil at a depth of 27 inches. The subsoil is very strongly acid.

These soils are well drained to moderately well drained and have moderately slow permeability in the fragipan. Available moisture capacity is good, and fertility is medium.

Most of the acreage is in timber, tame pasture, range, and cultivated crops.

Typical profile of Captina silt loam, about 280 feet south and 20 feet east of the northwest corner of section 31, T. 23 N., R. 25 E.:

A1—0 to 2 inches, dark grayish-brown (10YR 4/2) silt loam, grayish brown (10YR 5/2) when dry; weak, fine, granular structure; soft, very friable; strongly acid; clear, smooth boundary; horizon 1 to 6 inches thick.

A2—2 to 7 inches, grayish-brown (10YR 5/2) silt loam, very pale brown (10YR 7/3) when dry; weak, fine, granular structure; soft, very friable; strongly acid; clear, smooth boundary; horizon 4 to 16 inches thick.

B1—7 to 12 inches, yellowish-brown (10YR 5/4) silty clay loam, light yellowish brown (10YR 6/4) when dry; moderate, fine and medium, subangular blocky structure; hard, firm; few clay films; very strongly acid; gradual, smooth boundary; horizon 4 to 10 inches thick.

B21t—12 to 23 inches, dark yellowish-brown (10YR 4/4) silty clay loam, yellowish brown (10YR 5/4) when dry; moderate, medium, blocky structure; hard, firm; clay films on ped surfaces; very strongly acid; gradual, smooth boundary; horizon 8 to 20 inches thick.

B22t—23 to 27 inches, mottled yellowish-brown, dark yellowish-brown, and gray silty clay loam; moderate, medium, subangular blocky structure; hard, firm; clay films on some ped surfaces; very strongly acid; clear, smooth boundary; horizon 3 to 8 inches thick.

Bx1—27 to 38 inches, mottled gray, yellowish-brown, dark yellowish-brown, and yellowish-red silty clay loam; moderate, coarse, angular blocky structures; very hard, very firm; few, small, manganese concretions; clay films on some ped surfaces, organic stains in some root channels; very strongly acid; clear, smooth boundary; horizon 8 to 18 inches thick.

Bx2—38 to 50 inches, mottled yellowish-brown, brownish-yellow, and gray silty clay loam; moderate, coarse, subangular blocky structure; hard, firm; very strongly acid.

Color of the A1 horizon has a hue of 10YR, values of 4 to 6, and a chroma of 2. The A2 horizon has a hue of 10YR, value of 5 or 6, and chroma of 2 or 3.

Color of the B21t horizon is 7.5YR or 10YR in hue, 4 to 6 in value, and 4 to 8 in chroma. The B21t horizon is 0 to 10 percent chert, by volume, 28 to 35 percent clay, and less than 15 percent a material that ranges from very fine sand to 3-inch gravel. This horizon is medium acid to very strongly acid. Depth to the Bx horizon ranges from 20 to 40 inches. The Bx1 horizon is mottled silty clay loam. The Bx2 horizon is 5 to 50 percent chert, by volume.

The Captina soils have less cherty A and B horizons than the Clarksville soils and a less clayey B horizon than the Baxter soils. The fragipan that is characteristic of Captina soils is missing in the Baxter, Clarksville, Stigler, and Sallisaw soils.

Captina silt loam, 1 to 3 percent slopes (CaB).—This soil occupies timbered uplands in the cherty limestone areas of the county. The profile is the one described as typical for the series.

Included with this soil in mapping are areas of Locust cherty silt loam, totaling less than 10 percent of the acreage mapped, and of Baxter silt loam, totaling less than 8 percent. Also included are areas of a soil similar to this Captina soil but containing less clay in the upper part of the subsoil.

This Captina soil is used mostly for tame pastures, including fescue, bermudagrass, and clover. Some areas are cultivated to small grains, sorghums, fruits, and vegetables.

This soil is medium in fertility and responds to additions of fertilizer and other good management. Use of a large amount of crop residue helps in maintaining fertility and in keeping the surface layer in good tilth. Terraces and waterways may also be needed in some areas to control erosion. (Capability unit IIe-2; Smooth Chert Savannah range site; woodland suitability group 2)

Choteau Series

The Choteau series consists of deep, nearly level to very gently sloping soils that have a medium-textured surface layer and a moderately fine textured subsoil. They developed in material weathered from sandstone and shale in the northern part of Delaware County. Native vegetation is mostly big bluestem and little bluestem.

In a typical profile the surface layer, about 24 inches thick, consists of silt loam that is very dark grayish brown in the upper 15 inches and brown below (fig. 7). When moist, the surface layer is very friable in the upper part and friable in the lower part. The subsoil is silty clay loam 36 inches thick. It is yellowish brown mottled with strong brown in the upper part, yellowish brown mottled with reddish yellow and grayish brown in the middle, and mottled yellowish brown and gray in the lower part. The subsoil is firm or very firm when moist and hard or very hard when dry. Manganese concretions are common in the lower part of the subsoil.

These soils are well drained, have moderately slow permeability, and have good available moisture capacity. Fertility and the content of organic matter are high, and tilth generally is good. Crop growth can be increased by additions of lime and fertilizer.

These soils are used mostly for cultivated crops and tame grasses.

Figure 7.—Profile of a Choteau silt loam in a field of tall native grasses.

Profile typical of a Choteau silt loam, about 2,610 feet west and 520 feet north of the southeast corner of section 19, T. 25 N., R. 22 E.:

Ap—0 to 15 inches, very dark grayish-brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) when dry; moderate, medium, granular structure; slightly hard, very friable; moderately alkaline; clear, smooth boundary; horizon 10 to 20 inches thick.

A3—15 to 24 inches, brown (10YR 5/3) silt loam, pale brown (10YR 6/3) when dry; few, fine, faint mottles of brownish yellow (10YR 6/6); weak, fine, granular structure; hard, friable; medium acid; gradual, smooth boundary; horizon 6 to 15 inches thick.

B21t—24 to 32 inches, yellowish-brown (10YR 5/4) silty clay loam, light yellowish brown (10YR 6/4) when dry; common, medium, distinct mottles of strong brown (7.5YR 5/6); moderate, fine, subangular blocky structure; hard, firm; few manganese concretions and some chert fragments; clay films on peds; strongly acid; gradual, smooth boundary; horizon 5 to 12 inches thick.

B22t—32 to 49 inches, yellowish-brown (10YR 5/6) silty clay loam, brownish yellow (10YR 6/6) when dry; common medium, distinct mottles of reddish yellow (7.5YR 7/6) and grayish brown (10YR 5/2) below 44 inches; moderate, fine, subangular blocky structure; very hard, firm; common to many manganese concretions; thin, continuous clay films; some chert fragments; strongly acid; gradual, smooth boundary; horizon 10 to 24 inches thick.

B23t—49 to 60 inches, mottled yellowish-brown (10YR 5/6) and gray (10YR 5/1) silty clay loam; brownish yellow (10YR 6/6) and gray (10YR 6/1) when dry; moderate fine, subangular blocky structure; very hard, firm; common manganese concretions; few chert fragments; strongly acid.

Color of the Ap horizon is 10YR in hue, 3 in value, and 2 or 3 in chroma. The A3 horizon is 10YR in hue, 5 or 6 in value, and 2 to 4 in chroma.

The B2t horizon is 7.5YR or 10YR in hue, 4 or 5 in value, and 4 to 6 in chroma. Texture ranges from silty clay loam to clay loam and is 30 to 35 percent clay. Reaction ranges from strongly acid to medium acid. Color of the lower B2t horizon is 10YR or 7.5YR in hue, 5 or 6 in value, and 1 to 6 in chroma. Reaction ranges from strongly acid to mildly alkaline.

The lower part of the A horizon of Choteau soils is lighter colored than that of the Dennis, Newtonia, and Bates soils. Choteau soils are less clayey in the B horizon than are the Summit, Taloka, or Parsons soils. The change in texture from the A horizon to the B horizon is more gradual in the Choteau soils than in the Taloka or Parsons soils.

Choteau silt loam, 0 to 1 percent slopes (ChA).—This soil occurs on prairie uplands in the northern part of Delaware County. Its profile is similar to the one described for the series. The surface layer is a very dark grayish-brown silt loam about 17 inches thick. The subsoil is yellowish-brown silty clay loam that is mottled with yellowish red in the lower part.

Included with this soil in mapping are areas of Okemah silt loam, totaling less than 5 percent of the acreage mapped, and of Taloka silt loam, totaling less than 7 percent. Also included are soils similar to this Choteau soil that have more than 35 percent clay in the upper 20 inches of the subsoil.

When fertilized and properly managed, this Choteau soil is well suited to crops. It is used mostly for small grains, sorghums, soybeans, and tame pasture.

Good soil structure and fertility can be maintained by growing crops that produce large amounts of residue. If the residue is returned to the soil, it increases water intake and helps to prevent erosion on long slopes. (Capability unit I–2; Loamy Prairie range site; woodland suitability group, none)

Choteau silt loam, 1 to 3 percent slopes (ChB).—This soil occupies prairie uplands in the northern part of Delaware County. Its profile is the one described as typical for the series.

Included with this soil in mapping are areas of Dennis silt loam, totaling less than 7 percent of the acreage mapped, and of Choteau silt loam, 0 to 1 percent slopes, totaling less than 3 percent. Also included are soils similar to Choteau silt loam, 1 to 3 percent slopes, that have grayer mottles in the upper 20 inches of the subsoil. These included soils total about 10 percent of the acreage mapped.

This Choteau soil is used mainly for small grains, sorghums, soybeans, and tame pastures (fig. 8).

This soil has high natural fertility, but the growth of crops can be increased by additions of fertilizers and other good management. On some of the long slopes, terraces and waterways are needed for controlling erosion. The use of large amounts of crop residue increases the water intake and reduces erosion. (Capability unit IIe–1; Loamy Prairie range site; woodland suitability group, none)

Clarksville Series

The Clarksville series consists of deep, very gently sloping to steep soils that have a stony and cherty, medium-textured surface layer and a stony and cherty, moderately fine textured or fine textured subsoil (fig. 9). These soils formed in cherty limestone material. They occupy extensive areas of the uplands in Delaware County and the northern part of Cherokee County. Native vegetation is mainly oak, elm, hickory, hackberry, and shortleaf pine and an understory of mostly big bluestem and little bluestem.

In a typical profile the upper part of the surface layer

Figure 8.—**Multiple-use equipment used to drill wheat in Choteau silt loam, 1 to 3 percent slopes.**

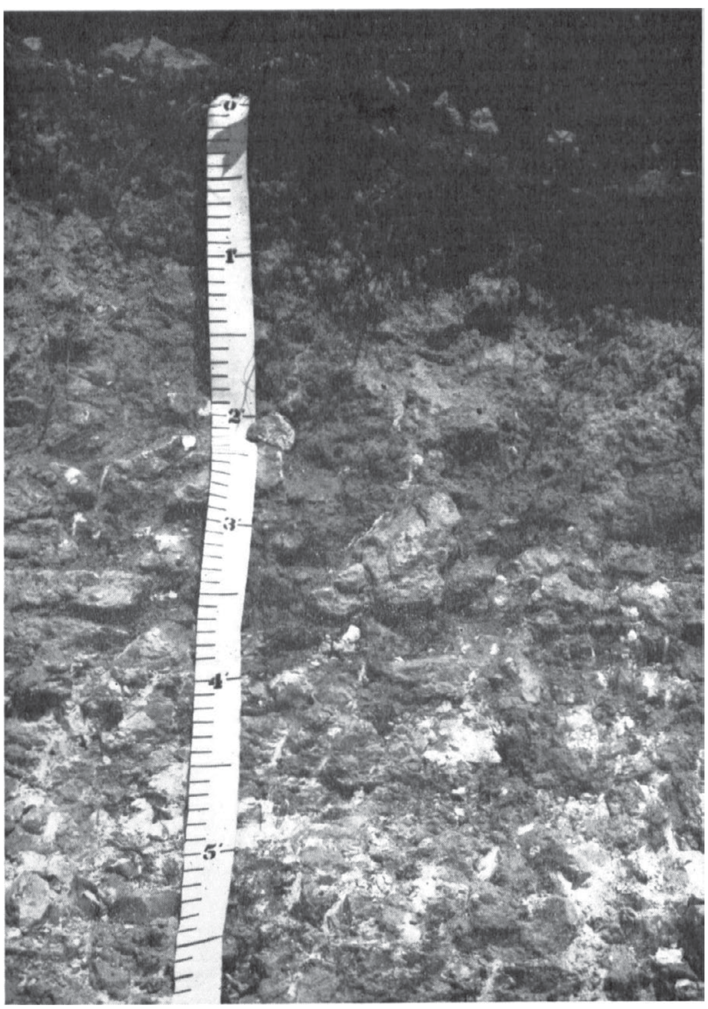

Figure 9.—**Profile of a Clarksville soil.**

is dark grayish-brown stony silt loam about 2 inches thick. The lower part is grayish-brown stony silt loam about 8 inches thick. The surface layer is very friable and is slightly acid in the upper part and strongly acid in the lower part. The subsoil extends to a depth of 60 inches. It is strong-brown, friable, very strongly acid, very stony silty clay loam to a depth of 40 inches. At this depth, the subsoil grades to chert beds and interlayers of brownish-yellow, friable, very strongly acid, stony and cherty silty clay loam that is mottled with brownish, reddish, and grayish colors.

These soils are well drained to excessively drained and are rapidly permeable. Because of the large amount of chert, available moisture capacity is low. Fertility is also low.

These soils are used mainly for timber and tame pasture. Cultivated crops are grown on some areas where slopes are less than 8 percent.

Typical profile of a Clarksville stony silt loam, about 820 feet north and 350 feet west of the southeast corner of section 31, T. 20 N., R. 24 E.:

A1—0 to 2 inches, dark grayish-brown (10YR 4/2) stony silt loam, grayish brown (10YR 5/2) when dry; about 30 percent stones and chert, by volume; weak, fine, granular structure; slightly hard, very friable; slightly acid; clear, smooth boundary; horizon 1 to 3 inches thick.

A2—2 to 10 inches, grayish-brown (10YR 5/2) stony silt loam, light gray (10YR 7/2) when dry; about 40 percent stones and chert, by volume; weak, fine, granular structure; slightly hard, very friable; strongly acid; gradual, smooth boundary; horizon 6 to 18 inches thick.

B1—10 to 20 inches, strong-brown (7.5YR 5/6) very stony silty clay loam, reddish yellow (7.5YR 6/6) when dry; about 60 percent stones and chert, by volume; moderate, fine, subangular blocky structure; hard, friable; clay films; very strongly acid; gradual, smooth boundary; horizon 3 to 14 inches thick.

B2t—20 to 40 inches, strong-brown (7.5YR 5/6) very stony silty clay loam, reddish yellow (7.5YR 6/6) when dry; a few, coarse, brown and gray mottles; about 70 percent stones and chert, by volume; moderate, fine, subangular blocky structure; hard, friable; thin continuous clay films on chert particles and soil particles; very strongly acid; gradual, smooth boundary; horizon 12 to 30 inches thick.

B3—40 to 60 inches, chert beds and interlayers of brownish-yellow (10YR 6/6) stony and cherty silty clay loam or cherty silty clay; mottled with strong brown, yellowish red, and gray; about 80 percent chert, by volume; moderate, very fine, blocky structure; hard, friable; clay films on chert and ped surfaces; very strongly acid.

Color of the A1 horizon is 10YR in hue, 4 or 5 in value, and 2 in chroma. The A1 horizon is 30 to 60 percent chert and stones, by volume. The A2 horizon is 10YR in hue, 5 or 6 in value, and 2 or 3 in chroma. It is 30 to 80 percent chert and stones, by volume. The chert in the A1 and A2 ranges from ½ to 15 inches in diameter and increases in amount with increasing depth.

The B1 horizon is 7.5YR or 10YR in hue, 4 or 5 in value, and 3 to 6 in chroma. It is 35 to 80 percent chert and stones, by volume. Color of the B2t horizon ranges from 10YR to 2.5 YR in hue, 4 to 5 in value, and from 3 to 8 in chroma. The B2t horizon is 35 to 90 percent chert and stones and 28 to 35 percent clay. It ranges from very strongly acid to strongly acid. The B3 horizon is similar to the B2 horizon, but it has a higher content of chert and more red and gray colors. Cherty limestone occurs at a depth of more than 6 feet.

These Clarksville soils have a higher percent of chert (more than 35 percent) in the B horizons than do the Baxter and Locust soils. The B2t horizon in the Clarksville soils is less

clayey than that in the Baxter soils. Clarksville soils do not have a fragipan, but the Captina soils do.

Clarksville stony silt loam, 5 to 20 percent slopes (ClE).—This deep, stony soil occupies timbered upland ridges in cherty limestone areas. The profile is similar to the one described as typical for the series. The surface layer is stony silt loam that is dark grayish brown in the upper 2 inches and is pale brown in the lower part. The subsoil is brown stony silty clay loam that is about 60 percent chert, by volume. The percentage of chert increases with depth.

Included with this soil in mapping are areas of Clarksville very cherty silt loam, totaling less than 6 percent of the acreage mapped; Sallisaw gravelly silt loam, totaling less than 3 percent; and of Clarksville stony silt loam, 20 to 50 percent slopes, totaling less than 5 percent.

Most Clarksville stony silt loam, 5 to 20 percent slopes, is in woodland, range, and tame pastures. The native vegetation is hardwood and pine and an understory of grass.

Good timber management and proper grazing are needed for continuous good growth of timber. If this soil is poorly managed, trees are of low quality and are very brushy. Brushy areas are generally cleared and planted to tame pastures (fig. 10).

Since it is stony, low in fertility, and droughty, this Clarksville soil generally is not used for general farm crops. It is, however, fairly well suited to pasture if brush is controlled and fertility maintained. Because this soil is highly susceptible to erosion in areas planted to strawberries, this crop needs to be grown in rotation with grasses and legumes. (Capability unit VIs–1; Smooth Chert Savannah range site; woodland suitability group 4)

Clarksville stony silt loam, 20 to 50 percent slopes (ClF).—This deep, stony soil occupies wooded uplands in the cherty limestone areas of the county. The profile is the one described as typical for the series.

Included with this soil in mapping are areas of Sallisaw gravelly silt loam, totaling less than 4 percent of the acreage mapped, and of Clarksville stony silt loam, 5 to 20 percent slopes, totaling less than 5 percent. Soils similar to Sallisaw soils on slopes of more than 8 percent occupy less than 4 percent of the area mapped.

This Clarksville soil is used mostly for timber and grass (fig. 11).

Good management of timber and grass helps control erosion, but the use of machinery is very difficult because of stones and steep slopes. (Capability unit VIIs–1; Steep Chert Savannah range site; woodland suitability group 6)

Clarksville very cherty silt loam, 1 to 8 percent slopes (CkD).—This soil occupies narrow convex ridges between the steep, deep drainageways in timbered, cherty limestone areas. The profile is similar to the one described for the series, except that it is less stony. The surface layer is dark grayish-brown very cherty silt loam that grades to brown colors at a depth of 3 inches. The subsoil is a brown very cherty silty clay loam that grades to red colors at a depth of below 21 inches.

Included with this soil in mapping are areas of Locust cherty silt loam, totaling less than 3 percent of the acreage mapped; of Clarksville stony silt loam, 5 to 20 percent slopes, totaling less than 5 percent; and of Baxter cherty silt loam, totaling less than 15 percent. Soils in which the surface layer and subsoil together are less than 6 feet thick occupy less than 3 percent of the areas mapped.

Most of this Clarksville soil is wooded or in grass. A small acreage is used for strawberries.

Where timber is poor in quality, it may be removed and the soil sprigged to bermudagrass. This can be done where the regrowth of brush is controlled. The very cherty surface helps to reduce the effects of erosion on this soil, but it makes tillage difficult. Where this soil is cultivated, a large amount of crop residue returned to the surface layer helps to improve fertility. (Capability unit IVs–1; Smooth Chert Savannah range site; woodland suitability group 4)

Figure 10.—**Clarksville stony silt loam, 5 to 20 percent slopes, is cleared of brush and is to be planted to bermudagrass.**

Figure 11.—**Pine seedlings growing on Clarksville stony silt loam, 20 to 50 percent slopes.**

Collinsville Series

The Collinsville series consists of very shallow to shallow, gently sloping soils. These soils have a moderately coarse textured layer over sandstone and occupy prairie areas of Cherokee County. Native vegetation is mostly little bluestem, big bluestem, and indiangrass.

In a typical profile the surface layer is very dark grayish-brown fine sandy loam about 6 inches thick. It is very friable when moist and is strongly acid. The subsoil is a very dark grayish-brown fine sandy loam about 7 inches thick. It is friable when moist and is strongly acid. The substratum is partly weathered sandstone that occurs at a depth of 13 inches.

The Collinsville soils are well drained and moderately rapid in permeability. They are shallow over bedrock and have low available moisture capacity. The content of organic matter is good, but natural fertility is only fair.

These soils are used mostly for native grass, but a few areas support tame grasses.

Typical profile of Collinsville fine sandy loam, 2 to 5 percent slopes, about 400 feet west and 150 feet north of the southeast corner of section 36, T. 16 N., R. 20 E.:

A1—0 to 6 inches, very dark grayish-brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) when dry; weak, fine, granular structure; slightly hard, very friable; strongly acid; gradual, smooth boundary; horizon 2 to 10 inches thick.

B—6 to 13 inches, very dark grayish-brown (10YR 3/2) heavy, fine sandy loam, grayish brown (10YR 5/2) when dry; weak, fine and medium, subangular blocky structure; hard, friable; few worm casts; few weathered sandstone fragments in the lower part; strongly acid; clear, irregular boundary; horizon 6 to 10 inches thick.

R—13 inches +, partly weathered sandstone bedrock.

Color of the A horizon is 10YR or 7.5YR in hue, 2 to 3.5 in value (3 to 5 when dry), and 2 in chroma. Fine sandy loam is the dominant texture, but texture ranges to stony sandy loam in places. The reaction ranges from slightly acid to strongly acid.

The thin B horizon has a range in color similar to that of the A1 horizon, but the B horizon contains slightly more clay than that A1 horizon. The depth to sandstone ranges from 8 to 20 inches, but is typically more than 10 inches. The sandstone is hard, fractured, and partly weathered.

The B horizon of Collinsville soil is less clayey than that of the Linker, Bates, and Dennis soils and is nearer the surface than in the Bates and Dennis soils.

Collinsville fine sandy loam, 2 to 5 percent slopes (CoC).—This very shallow to shallow soil occupies prairie uplands in the sandstone areas. The soil profile is the one described as typical for the series.

Included with this soil in mapping are areas of Bates loam, totaling less than 10 percent of the acreage mapped; of Dennis silt loam, totaling less than 3 percent; and outcrops of rocks, totaling less than 5 percent. Also included are small areas of moderately eroded soils, and some areas of a soil that has a more reddish subsoil than this Collinsville soil.

Nearly all of this soil is in grass that is used for hay and grazing.

Keeping a good cover of grass on this soil is the best way of controlling erosion. This soil generally is too shallow, too stony, and too droughty for cultivation. A few small areas are cultivated where the soil is nearly 20 inches over sandstone. If these areas are cultivated, field crops need to be used with grass and legumes in a long-term rotation in order to prevent erosion. (Capability unit VIe-2; Shallow Prairie range site; woodland suitability group, none)

Dennis Series

The Dennis series consists of deep, very gently sloping soils that have a dark-colored, medium-textured surface layer and a moderately fine textured subsoil. These soils developed in material weathered from sandstone and shale on prairie uplands. The native vegetation consists mainly of little bluestem, big bluestem, indiangrass, and switchgrass.

In a typical profile the surface layer is very dark grayish-brown silt loam about 13 inches thick. It is friable when moist and is neutral. The subsoil is silty clay loam that extends to a depth of more than 50 inches. The upper part is dark brown and about 5 inches thick. The next layer is dark yellowish brown that grades to mottled brown, yellowish brown, strong brown, and yellowish red at a depth of about 34 inches. Below that depth is silty clay loam coarsely mottled with brownish and reddish colors. The subsoil is firm when moist, contains a few concretions of iron and manganese, and is strongly acid. A few chert fragments occur above a depth of 34 inches.

The Dennis soils are well drained and slowly permeable. These soils contain a large amount of organic matter, are high in natural fertility, and are easily tilled. They are well suited to crops. Adding fertilizer and lime increases crop growth.

These soils are used mostly for cultivated crops and tame grasses.

Typical profile of Dennis silt loam, 1 to 3 percent slopes, about 1,060 feet west and 180 feet north of the southeast corner of section 35, T. 25 N., R. 24 E.:

A1—0 to 13 inches, very dark grayish-brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) when dry; moderate, fine and medium, granular structure; hard, friable; some worm casts; very few, small, hard concretions of manganese and iron; few, small, chert fragments; neutral; gradual, smooth boundary; horizon 10 to 16 inches thick.

B1—13 to 18 inches, dark-brown (10YR 3/3) silty clay loam, brown (10YR 4/3) when dry; common, fine, faint, strong-brown mottles and few, fine, distinct, yellowish-red mottles; moderate, medium, subangular blocky structure; hard, friable; few, fine, slightly hard, black concretions; organic stains in some root channels; thin continuous clay films on ped surfaces; few, small, chert fragments; medium acid; gradual, smooth boundary; horizon 3 to 10 inches thick.

B21t—18 to 34 inches, dark yellowish-brown (10YR 4/4) heavy silty clay loam, yellowish brown (10YR 5/4) when dry; common, fine, faint, yellowish-brown and strong-brown mottles and few, fine, prominent, yellowish-red (5YR 4/6) mottles; strong, medium and fine, blocky structure; very hard, firm; continuous clay films on ped surfaces; few, fine, hard, black concretions of manganese and red concretions of iron; few, small, chert fragments; strongly acid; gradual, smooth boundary; horizon 10 to 24 inches thick.

B22t—34 to 44 inches, coarsely mottled brown (10YR 4/3), yellowish-brown (10YR 5/8), strong-brown (7.5YR 5/8), and yellowish-red (5YR 4/6) silty clay loam; moderate, medium, subangular blocky structure; very hard, firm; continuous clay films on peds; few, medium, black concretions of manganese; few, small, chert fragments; strongly acid; gradual, smooth boundary; horizon 6 to 16 inches thick.

B3—44 to 66 inches, coarsely mottled grayish-brown (10 YR 5/2), strong-brown (7.5YR 5/8), and yellowish-red (5YR 5/6) silty clay loam; moderate, medium, subangular blocky structure; very hard, firm; clay films on ped surfaces; common, medium, black concretions of manganese; few, small chert fragments; medium acid.

Color of the A1 horizon is 10YR in hue, 3 in value, and 2 or 3 in chroma. The B1 horizon is 10YR in hue, 3 to 5 in value, and 2 to 4 in chroma. The B21t horizon ranges from 7.5YR to 10YR in hue, 4 to 5 in value, and 3 to 6 in chroma. Grayish mottles occur from 20 to 40 inches below the upper part of the B horizon. The B21t horizon ranges from silty clay loam to silty clay (35 to 50 percent clay) in texture; reaction ranges from slightly acid to strongly acid. The B3 horizon is similar to the B2t horizon, except that it has more gray colors. It ranges from medium acid to mildly alkaline.

The Dennis soils are similar to the Okemah soils, but grayish mottles in the Dennis soils are generally more than 20 inches below the top of the B horizon. Texture between the A horizon to the B2t horizon changes more gradually in the Dennis soils than in the Taloka, Woodson, and Parsons soils. In the Dennis soils the B2t horizon is more clayey than that in the Bates soils and more brownish than that in the Summit and Newtonia soils.

Dennis silt loam, 1 to 3 percent slopes (DnB).—This deep, loamy soil occurs on the prairie uplands of the county. The profile is the one described for the series.

Included with this soil in mapping are areas of Okemah silt loam, totaling less than 3 percent of the acreage mapped; of Choteau silt loam, totaling less than 5 percent; and of Bates loam, totaling less than 5 percent. Some small areas are eroded.

This soil is used mostly for wheat, grain sorghum, corn, soybeans, and tame pasture. A small acreage is in range grasses.

This Dennis soil is subject to erosion unless protected by crops that produce large amounts of residue, by terraces, and by waterways. Returning crop residue to the soil is a practice that increases water intake, improves tilth, and increases fertility. (Capability unit IIe-1; Loamy Prairie range site; woodland suitability group, none)

Eldorado Series

The Eldorado series consists of deep, very gently sloping to strongly sloping soils that have a cherty surface layer and a very cherty subsoil. These soils developed in weathered material from cherty limestone on the prairie uplands. The native vegetation consists mostly of little bluestem, big bluestem, indiangrass, and switchgrass.

In a typical profile the surface layer is very dark grayish-brown cherty silt loam about 11 inches thick. It is very friable when moist and is medium acid. The upper 11 inches of the subsoil is dark-brown very cherty silt loam. Below this is dark-brown very cherty silty clay loam that grades to mottled red, yellowish-red, and gray very cherty silty clay loam at a depth of about 44 inches. The subsoil ranges from about 35 to 90 percent chert, by volume. It is firm when moist and is strongly acid.

These soils are well drained and have moderately rapid permeability. They have a high content of organic matter and good natural fertility. Because they are very cherty, however, these soils store only a small amount of moisture.

The Eldorado soils are used mostly for native grass.

Typical profile of Eldorado soils, about 2,240 feet south and 20 feet west of the northeast corner of section 30, T. 25 N., R. 24 E.:

A1—0 to 11 inches, very dark grayish-brown (10YR 3/2) cherty silt loam, dark grayish brown (10YR 4/2) when dry; moderate, very fine and fine, granular structure; slightly hard, very friable; medium acid; clear, smooth boundary; horizon 6 to 15 inches thick.

B1—11 to 22 inches, dark-brown (10YR 3/3) very cherty heavy silt loam, dark brown (10YR 4/3) when dry; moderate, medium, subangular blocky structure; hard, friable; clay films on ped surfaces; about 60 percent chert, by volume; medium acid; clear, smooth boundary; horizon 8 to 18 inches thick.

B21t—22 to 33 inches, dark-brown (10YR 4/3) very cherty silty clay loam, brown (10YR 5/3) when dry; few, fine, prominent, yellowish-red mottles; moderate, medium, subangular blocky structure; hard, firm; clay films on ped surfaces; about 75 percent chert, by volume; amount of chert increases with increasing depth; strongly acid; clear, smooth boundary; horizon 6 to 15 inches thick.

B22t—33 to 44 inches, yellowish-red (5YR 5/6) very cherty light silty clay loam, reddish yellow (5YR 6/6) when dry; common, medium, distinct, brownish-yellow (10YR 6/6) mottles in upper part and common, medium, prominent, gray (10YR 5/1) mottles in lower part; moderate, fine, subangular blocky structure; hard, firm; clay films on ped surfaces; about 80 percent chert, by volume; strongly acid; gradual, smooth boundary; horizon 8 to 16 inches thick.

B3—44 to 63 inches, mottled red (2.5YR 4/6), yellowish-red (5YR 5/6), and gray (10YR 5/1) very cherty silty clay loam; moderate, fine and medium, subangular blocky structure; hard, firm; clay films on ped surfaces; about 80 percent chert, by volume; few stones; strongly acid.

The A1 horizon is silt loam, cherty silt loam, or stony silt loam and is about 5 to 30 percent chert, by volume. Color of the A1 horizon is 10YR in hue, 3 in value, and 2 or 3 in chroma.

The B21t horizon ranges from very cherty heavy silt loam to stony silty clay loam and is about 25 to 35 percent clay and about 35 to 90 percent chert, by volume. The B21t horizon has colors ranging from 10YR to 5YR in hue, 4 to 5 in value, and 3 to 8 in chroma. This horizon is medium acid to very strongly acid. The lower part of the B horizon ranges from very cherty silty clay loam to very cherty clay.

The Eldorado soils occur with Dennis, Bates, Summit, and Newtonia soils, which do not have a very cherty B horizon (more than 35 percent chert).

Eldorado silt loam, 1 to 3 percent slopes (EdB).—This deep, loamy soil occupies prairie uplands in cherty limestone areas. The profile of this soil is similar to the one described as typical for the series but is slightly less cherty in the upper part (fig. 12). The surface layer is a very dark grayish-brown silt loam about 14 inches thick. The dark-brown upper part of the subsoil is silty clay loam that grades to dark grayish-brown cherty silty clay loam at a depth of about 21 inches. Below a depth of 32 inches, the profile is a very cherty silt loam that is about 70 percent chert, by volume.

Included with this soil in mapping are areas of Eldorado soils, 3 to 12 percent slopes, totaling less than 4 percent of the acreage mapped. Also included are areas of Dennis silt loam, totaling less than 3 percent, and of Eldorado silt loam, 3 to 5 percent slopes, totaling less than 6 percent. About 10 percent of the area is occupied by mounds 15 to 30 feet across and 1 to 3 feet high that are similar to Eldorado silt loam but have a surface layer that is 15 to 25 percent chert, by volume. A few small areas are eroded.

This Eldorado silt loam is used mostly for wheat, sorghums, soybeans, tame pasture, and native grass.

Cultivated areas of this soil are eroded unless they are protected by contour farming, terraces, and crop residue.

Figure 12.—**Profile of Eldorado silt loam, 1 to 3 percent slopes, showing roots of native grass.**

This soil has a high content of chert and is droughty. Additions of fertilizer are needed to help increase the amount of crop residue. The return of crop residue to the soil improves the structure of the surface layer, increases intake of water, and makes the soil better suited to crops. (Capability unit IIe–1; Loamy Prairie range site; woodland suitability group, none)

Eldorado silt loam, 3 to 5 percent slopes (EdC).—This deep, loamy soil occurs in cherty limestone areas of prairie uplands. The profile is similar to the one described for the series, but it is less cherty in the upper part. The surface layer is very dark grayish-brown silt loam about 10 inches thick. The subsoil is a dark-brown silty clay loam in the upper part and dark grayish-brown very cherty silty clay loam at a depth of about 18 inches. Below a depth of 30 inches, the chert content is about 70 to 80 percent by volume.

Included with this soil in mapping are areas of Eldorado soils, 3 to 12 percent slopes, totaling less than 10 percent of the acreage mapped, and of Eldorado silt loam, 1 to 3 percent slopes, totaling less than 3 percent. Also included, in about 10 percent of the area mapped, are mounds made up of soil similar to Eldorado silt loam, except that the surface layer has a chert content of 15 to 25 percent by volume. These mounds are 15 to 30 feet across and 1 to 3 feet high. Some small areas are eroded.

This Eldorado soil is mostly in tame pasture or native grass. Some areas are cultivated to small grains, sorghums, and soybeans.

In cultivated areas terraces, contour farming and the use of crop residue help prevent erosion. The use of large amounts of crop residue increases the organic matter in the surface layer and helps maintain soil structure and tilth. (Capability unit IIIe–1; Loamy Prairie range site; woodland suitability group, none)

Eldorado soils, 3 to 12 percent slopes (EID).—These deep soils occur in cherty limestone areas on prairie uplands. They are made up of silt loam, cherty silt loam, and stony silt loam that are in areas too small and intermingled to be mapped separately. Except for texture of the surface layer, the profile is similar to the one described as typical for the series.

Included with these soils in mapping are areas of Eldorado silt loam, 1 to 3 percent slopes, totaling less than 10 percent of the acreage mapped.

These soils are in native grass and are used for range and hay. They are too stony, too droughty, and generally too steep for cultivation. If properly managed, they are fairly well suited to pasture or hay. In overgrazed areas the grasses are often replaced by weeds and sprouts. The weeds and brush need to be controlled by mowing or spraying and then reseeding the areas to grass. (Capability unit VIs–2; Loamy Prairie range site; woodland suitability group, none)

Elsah Series

The Elsah series consists of nearly level to slightly undulating soils that have a very gravelly, medium-textured surface layer and subsoil. These soils developed in gravelly alluvium on streambeds that are frequently flooded. They support mostly sycamore, oak, elm, hickory, walnut, and maple trees.

In a typical profile the surface layer consists of dark-brown, friable, medium acid, very gravelly loam about 15 inches thick. It is about 70 percent gravel, by volume. The subsoil is dark grayish-brown very gravelly loam and is 70 to 90 percent gravel, by volume. It is friable when moist and medium acid.

Elsah soils are excessively drained and have rapid permeability. They generally have a high content of organic matter and are fairly fertile. Since these soils are very gravelly, the available moisture capacity is low, but in many areas the water table is within the root zone of large trees. These soils are used mostly for timber; they flood too often for growth of crops.

Typical profile of Elsah soils, about 400 feet south of the northwest corner of section 35, T. 17 N., R. 23 E.:

A1—0 to 15 inches, dark-brown (10YR 4/3) very gravelly loam, pale brown (10YR 6/3) when dry; weak, fine, granular structure; slightly hard, friable; about 70 percent gravel by volume; fragments range from 2 millimeters to 4 inches in size; medium acid; gradual, irregular boundary; horizon 7 to 20 inches thick.

B—15 to 60 inches, dark grayish-brown (10YR 4/2) very gravelly loam, light brownish gray (10YR 6/2) when dry; weak, fine, granular structure; slightly hard, friable; about 70 to 90 percent gravel and cobblestones by volume; medium acid.

Color of the A horizon is 10YR in hue, 3 to 5 in value, and 2 to 4 in chroma. This horizon is from 60 to 90 percent gravel, by volume; texture is very gravelly loam and very gravelly silt loam.

The B horizon is 10YR in hue, 4 or 5 in value, and 2 to 4 in chroma. The gravel content ranges from 60 to 90 percent, and thin layers of finer and coarser material are common. The reaction ranges from neutral to medium acid.

The Elsah soils are more gravelly than the Staser and Verdigris soils.

Elsah soils (0 to 2 percent slopes) (Es).—These deep soils occur in timbered areas on streambeds that are frequently flooded. They consist mostly of gravelly and loamy sediments washed from weathered cherty limestone and sandstone. Areas of very gravelly loam, very gravelly silt loam, and gravel occur, but the areas are too small and intermingled to be mapped separately. Except for the texture of the surface layer, the profile is similar to the one described as typical for the series.

Included with these soils in mapping are areas of Staser gravelly loam, totaling less than 10 percent of the acreage mapped, and of soils on gravelly stream channels less than 150 feet in width.

Elsah soils are used mainly for timber and grazing. In most areas bermudagrass or similar tame pasture plants can be established. The native vegetation consists mostly of hardwoods, willows, and brush and an understory of cool-season grasses.

Since this soil is frequently flooded and droughty, it is not used for cultivated crops. The hardwoods need to be thinned, managed, and harvested where they are not used for wildlife food and cover. (Capability unit Vw–1; no range site; woodland suitability group 1)

Hector Series

The Hector series consists of very shallow to shallow, gently sloping to steep soils that are moderately coarse textured over sandstone. They occur on uplands in the southern part of Cherokee County. The Hector soils are extensive and support mostly oak, elm, hickory, and hackberry trees and an understory that is mainly big bluestem and little bluestem.

In a typical profile the surface layer is dark-brown fine sandy loam about 7 inches thick. It is very friable when moist and is slightly acid. The subsoil is strong-brown fine sandy loam about 8 inches thick. It is friable when moist and is strongly acid. Sandstone bedrock is at a depth of 15 inches.

These soils are somewhat excessively drained and have moderately rapid permeability. They contain a small amount of organic matter and are low in natural fertility. Because texture is moderately coarse and sandstone is near the surface, these soils have low available water capacity.

The Hector soils are used mostly for range, but there are small amounts of timber. These soils are only moderately well suited to timber.

Typical profile of Hector fine sandy loam, southeast quarter of northeast quarter of section 13, T. 14 N., R. 23 E.:

A1—0 to 7 inches, dark-brown (7.5YR 4/3) fine sandy loam, brown (10YR 5/3) when dry; moderate, medium and fine, granular structure; slightly hard, very friable; slightly acid; gradual, smooth boundary; horizon 5 to 10 inches thick.

B—7 to 15 inches, strong-brown (7.5YR 5/6) fine sandy loam, reddish yellow (7.5YR 6/6) when dry; weak, fine and medium, subangular blocky structure; slightly hard, friable; strongly acid; horizon 2 to 12 inches thick.

R—15 inches +, sandstone bedrock.

The color of the A horizon is 7.5YR or 10YR in hue. Value is 3 or 4 (moist) and 4 or 5 (dry). Chromas range from 2 to 4. The A1 horizon contains fragments of sandstone in some places. The content of organic matter is less than 1 percent.

The B horizon ranges from 5YR to 10YR in hue. Value is 4 or 5 (moist) and 5 or 6 (dry). Chromas range from 6 to 8. Reaction of the B horizon ranges from slightly acid to strongly acid. Texture ranges from fine sandy loam to sandy clay loam; content of clay is 12 to 22 percent. Few to many sandstone fragments occur in the B horizon. Thickness of the solum and depth to bedrock range from 8 to 20 inches.

The B horizon of Hector soils is less clayey than that of Linker soils.

Hector fine sandy loam, 2 to 5 percent slopes (HcC).—This very shallow to shallow soil occurs on timbered uplands in sandstone areas of the county. The profile is the one described as typical for the series. Included with this soil in mapping are areas of Linker fine sandy loam, totaling about 6 percent, and of Hector-Linker association, totaling less than 4 percent. About 5 percent of the area mapped consists of eroded soils.

Because most of this soil is cutover areas of woodland and brush, it is used mostly for tame pasture, range, and, to a limited extent, for timber. Some areas are cultivated to small grains and sorghums, but the soil is generally too shallow, droughty, and erodible for good growth of crops. Production of timber is fair where the brush is controlled and trees are properly harvested.

Although this soil is low in productivity, planting it to tame pasture grasses is an effective way to control erosion and maintain soil structure and fertility (fig. 13). (Capability unit VIe–1; Shallow Savannah range site; woodland suitability group 3)

Hector-Linker association, hilly (8 to 30 percent slopes) (HlE).—These moderately coarse textured soils occupy timbered uplands in sandstone areas. The association consists of about 45 percent Hector soils and about 35 percent Linker soils. The shallow Hector soils have a thin, dark-brown stony fine sandy loam surface layer about 7 inches thick. The subsoil is strong-brown stony fine sandy loam. The Linker soils have a thin, dark-brown stony fine sandy loam surface layer about 6 inches thick. Their subsoil is yellowish-red light clay loam that is underlain by sandstone at a depth of about 32 inches.

Included with this association in mapping are sandstone outcrops or soils similar to Hector soils that are less than 8 inches deep over sandstone. Also included are soils similar to Linker soils that have a subsoil with a content of clay of more than 35 percent. Each kind of soil totals about 10 percent of the area mapped.

Most of this association is brushy and is used for grazing and tame pastures. Hardwoods grow well on the deeper Linker soils but are of low quality on the Hector and shallower soils.

The weeding of low-quality trees helps to keep these soils from converting to brush. Good management of range grasses and limited brush control are needed if pasture is to be of good quality. Managing for range or hardwood production is very difficult on the steeper slopes of this association. (Both soils in capability unit VIIs–5; Hector soils in Shallow Savannah range site and Linker soils in Sandy Savannah range site; both soils in woodland suitability group 6).

Jay Series

The Jay series consists of deep, nearly level to very gently sloping soils on prairie uplands. These soils have a thick, medium-textured surface layer, a moderately fine textured subsoil, and a moderately fine textured fragipan at a depth of about 24 inches. They developed in loamy

Figure 13.—**Hector fine sandy loam, 2 to 5 percent slopes, has been cleared of brush and planted to tame pasture grasses. The regrowth of brush will need to be controlled for maximum production of grass.**

sediments. The vegetation is of the prairie type and consists mostly of little bluestem, big bluestem, indiangrass, and switchgrass.

In a typical profile the surface layer is dark-brown silt loam about 13 inches thick. It is friable when moist and is strongly acid. The subsoil, to a depth of 24 inches, is yellowish-brown silty clay loam that has a few yellowish-brown mottles. It is friable when moist and is very strongly acid. The fragipan is silty clay loam that is very firm and brittle when moist. It extends to a depth of 70 inches. The upper 2 inches is mottled with yellowish brown and grayish brown. Below this are light brownish-gray, strong-brown, and yellowish-brown mottles that grade to strong-brown, yellowish-red, gray, and red mottles at a depth of about 55 inches. The fragipan is very strongly acid to a depth of 41 inches, and is strongly acid below. Slightly hard concretions of manganese make up 15 percent of the layer below a depth of 55 inches.

The Jay soils are moderately well drained and are moderately permeable above the fragipan and are slowly permeable within it. They have good available moisture capacity.

These soils are fairly suitable for cultivation, though they are wet for short periods. They have a moderate content of organic matter in the surface layer and are generally easily tilled. Natural fertility is fair, but crop growth can be increased by adding lime and fertilizer.

Profile of Jay silt loam, about 60 feet southeast of the northwest corner of section 36, T. 19 N., R. 22 E.:

Ap—0 to 13 inches, dark-brown (10YR 3/3) silt loam, brown (10YR 5/3) when dry; moderate, fine and medium, granular structure; slightly hard, friable; strongly acid; smooth, gradual boundary; horizon 10 to 18 inches thick.

B2t—13 to 24 inches, yellowish-brown (10YR 5/4) light silty clay loam, light yellowish brown (10YR 6/4) when dry; few, fine, faint yellowish-brown mottles; moderate, fine and medium, subangular blocky structure; hard, friable; thin continuous clay films on ped surfaces; very strongly acid; gradual, smooth boundary; horizon 8 to 16 inches thick.

B′x1&A′2x—24 to 26 inches, mottled yellowish-brown (10YR 5/4) and grayish-brown (10YR 5/2) light silty clay loam; common, fine, distinct mottles of strong brown (7.5YR 5/6) and prominent mottles of yellowish-red (5YR 5/6); moderate, fine, subangular blocky structure; very hard, firm; continuous clay films on all ped surfaces; few, medium, strong-brown and yellowish-red soft concretions of iron; very strongly acid; clear, smooth boundary; horizon 2 to 6 inches thick.

B′x2—26 to 41 inches, mottled light brownish-gray (10YR 6/2), strong-brown (7.5YR 5/6), yellowish-brown

(10YR 5/6), and yellowish-red (5YR 5/6) light silty clay loam; moderate, medium, blocky structure with coarse polygons; very hard, very firm and brittle; continuous thin clay films on surfaces of peds, in pores, and in root channels; horizon about 5 percent slightly hard concretions of black manganese and of yellowish-red iron; very strongly acid; gradual, smooth boundary; horizon 10 to 24 inches thick.

B'x3—41 to 55 inches, mottled yellowish-brown (10YR 5/8), pale-brown (10YR 6/3), light brownish-gray (10YR 6/2), and yellowish-red (5YR 5/6) silty clay loam; moderate, medium, blocky structure with coarse polygons; very hard, very firm and brittle; thin continuous clay films; numerous manganese films on horizontal plane of polygons, about 10 percent slightly hard manganese concretions; strongly acid; gradual, wavy boundary; horizon 8 to 20 inches thick.

B'x4—55 to 70 inches, mottled strong-brown (7.5YR 5/6), yellowish-red (5YR 6/6), gray (10YR 5/1) and red (2.5YR 4/8) silty clay loam; coarse polygonal and moderate, coarse, blocky structure; very hard, very firm and brittle; thick continuous clay films on the reddish material and thinner clay films on the more yellowish and grayish material; thin black films on horizontal faces of polygons; about 15 percent of horizon is slightly hard manganese concretions and few soft, reddish iron concretions; slightly acid.

Color of the A horizon is 10YR in hue, 3 in value, and 2 or 3 in chroma. In some places, the A horizon is slightly lighter colored in the lower part.

The B2t horizon is 10YR and 7.5YR in hue, 4 or 5 in value, and 3 to 6 in chroma. It ranges from heavy silt loam to light silty clay loam and is less than 35 percent clay. In places grayish mottles having a chroma of 1 or 2 occur below the upper 10 inches of the B2t horizon. This horizon is medium to very strongly acid.

The B'x1&A'2x horizon is generally more grayish than the B2t horizon but does not occur in some areas. The B'x horizons are yellowish brown to yellowish red variegated with light brownish gray, pale brown, and gray. These horizons range from heavy silt loam to light silty clay loam in texture and are less than 35 percent clay. Their reaction ranges from strongly acid to very strongly acid in the upper part and from slightly acid to medium acid in the lower part.

The Jay soils are similar to the Choteau soils in color and texture, but the Choteau soils do not have fragipans in the lower part of the B horizon. The Jay soils are less clayey in the B horizon than the Taloka soils.

Jay silt loam, 0 to 2 percent slopes (JaA).—This deep, loamy soil occupies uplands in prairie areas. Its profile is the one described as typical for the series.

Included with this soil in mapping are areas of Taloka silt loam, totaling less than 5 percent of the acreage mapped. Also included are areas of soils that are similar to the Jay soils but are slightly wetter with gray mottles but no clay films in the upper part of the subsoil above the fragipan. These included areas are about 20 percent of the acreage mapped.

This Jay soil is used mostly for tame pasture and native grass. A few areas are in small grains, sorghums, and soybeans, though wetness is a slight hazard in cultivated areas. Heavily fertilized areas are well suited to field crops and tame pasture grasses.

Management is needed to prevent water erosion on long slopes. Erosion can be controlled without terraces where large amounts of plant residue are returned to the soil to increase water intake and to improve soil structure and fertility. (Capability unit IIe-2; Loamy Prairie range site; woodland suitability group, none)

Linker Series

The Linker series consists of moderately deep, gently sloping to steep soils that have a light-colored, moderately coarse textured surface layer over a subsoil that is mostly moderately fine textured. These soils developed in material weathered from sandstone. They occur in extensive areas of the uplands mostly in the southern part of Cherokee County. The native vegetation is mostly oak, elm, hickory, and hackberry and an understory consisting mainly of big bluestem and little bluestem.

In a typical profile the surface layer is dark-brown fine sandy loam about 6 inches thick. It is very friable when moist and is medium acid. The yellowish-red subsoil extends to a depth of about 39 inches. It is loam in the upper 5 inches and light clay loam below. The subsoil is medium acid.

Underlying the subsoil is yellowish-red weathered sandstone that is partly consolidated and very strongly acid.

The Linker soils are well drained and moderately permeable. They have moderate amounts of organic matter in the surface layer, are fairly fertile, and have a fair available moisture capacity.

Gently sloping Linker soils are used for cultivated crops, tame grasses, and range. The steeper soils are in small amounts of timber. In cultivated areas timber soils respond well to additions of lime and fertilizer.

Typical profile of Linker fine sandy loam in section 1, T. 14 N., R. 22 E.:

Ap—0 to 6 inches, dark-brown (10YR 4/3) fine sandy loam, brown (10YR 5/3) when dry; weak, fine, granular structure; slightly hard, very friable; medium acid; gradual, smooth boundary; horizon 4 to 10 inches thick.

B1—6 to 11 inches, yellowish-red (5YR 4/6) loam, reddish yellow (5YR 6/6) when dry; moderate, fine, subangular blocky structure; slightly hard, friable; medium acid; gradual, smooth boundary; horizon 4 to 9 inches thick.

B2t—11 to 28 inches, yellowish-red (5YR 4/6) light clay loam, reddish yellow (5YR 6/6) when dry; moderate, medium, subangular blocky structure; hard, firm; thin, patchy clay films; medium acid; gradual, smooth boundary; horizon 10 to 20 inches thick.

B3—28 to 39 inches, yellowish-red (5YR 4/6) light clay loam, reddish yellow (5YR 6/6) when dry; moderate, coarse, subangular blocky structure; hard, friable; medium acid; gradual boundary; horizon 4 to 8 inches thick.

R—39 inches +, yellowish-red (5YR 4/6), partly consolidated, weathered, very strongly acid sandstone.

Color of the A horizon is 10YR or 7.5YR in hue, 3 or 4 in value (moist), 4 to 6 in value (dry), and 2 to 4 in chroma. The A horizon is less than 6 inches thick where its value (moist) is less than 3.5. It is fine sandy loam in most places but ranges to loam. In virgin areas, there is a brown to light brownish-gray A2 horizon. The B2t horizon is 5YR or 2.5YR in hue, 4 to 6 in value (moist), 5 or 6 in value (dry), and 4 to 6 in chroma. Texture is light clay loam, but it is loam in the upper part in some places and ranges to sandy clay loam in which the content of clay is less than 35 percent. The solum ranges from 20 to 40 inches in depth over bedrock. In some places, sandstone fragments occur in all horizons. The reaction of any horizon ranges from medium acid to very strongly acid.

The Linker soils are deeper to bedrock and contain more clay in the B horizon than the Hector soils.

Linker fine sandy loam, 2 to 5 percent slopes (LkC).—This moderately deep soil occurs on timbered uplands in sandstone areas. The profile is the one described as typical

for the series. Included with this soil in mapping are areas of Hector fine sandy loam, totaling less than 5 percent of the acreage mapped, and small eroded areas of Linker soils totaling less than 8 percent.

Nearly all of this soil is cleared of timber and is in cultivated crops or tame pasture. The main cultivated crops are small grains and sorghums.

Cultivated areas of this soil are subject to soil blowing and water erosion. Practices that help control erosion and improve soil structure and fertility are terracing and contour farming and adding fertilizer so that large amounts of crop residue are produced for return to the soil. Mowing or spraying of pasture is needed to prevent the return of brush. (Capability unit IIIe-2; Sandy Savannah range site; woodland suitability group 2)

Locust Series

The Locust series consists of deep, very gently to gently sloping soils that developed in material weathered from cherty limestone on upland slopes. These soils have a cherty medium-textured surface layer and a cherty subsoil that is mostly moderately fine textured. A fragipan occurs at a depth of about 22 inches. The native vegetation is mainly oak and pine and an understory of grasses.

In a typical profile the surface layer, about 10 inches thick, is friable, strongly acid cherty silt loam that is about 15 percent chert, by volume. It is dark grayish brown in the upper 6 inches and is brown in the lower part. The subsoil extends to a depth of 42 inches. It is yellowish-brown, friable, strongly acid cherty silt loam in the upper 6 inches and yellowish-brown cherty silty clay loam in the next layer. Below a depth of 22 inches the subsoil grades to a very strongly acid fragipan of mottled yellowish-brown, gray, and strong-brown cherty silty clay loam. This layer is about 30 percent chert by volume.

These soils are well drained. Permeability is moderate above the fragipan and slow within it. They are poorly suited to most field crops because available water capacity is restricted somewhat by the high content of chert.

These soils are used mostly for tame pasture, but some areas are used for timber and range.

Typical profile of Locust cherty silt loam, about 2,540 feet west and 1,470 feet south of the northeast corner of section 16, T. 17 N., R. 22 E.:

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) cherty silt loam, light brownish gray (10YR 6/2) when dry; moderate, very fine and fine, granular structure; slightly hard, friable; about 15 percent chert, by volume; strongly acid; clear, smooth boundary; horizon 4 to 8 inches thick.

A2—6 to 10 inches, brown (10YR 5/3) cherty silt loam, pale brown (10YR 6/3) when dry; weak, fine and medium, granular structure; slightly hard, friable; about 20 percent chert, by volume; strongly acid; gradual, smooth boundary; horizon 8 to 13 inches thick.

B1—10 to 16 inches, yellowish-brown (10YR 5/4) cherty silt loam, light yellowish brown (10YR 6/4) when dry; common, fine, prominent, reddish-yellow mottles (5YR 6/6); moderate, fine, subangular blocky structure; hard, friable; about 25 percent chert, by volume; strongly acid; gradual, smooth boundary; horizon 4 to 8 inches thick.

B2t—16 to 22 inches, yellowish-brown (10YR 5/4) cherty silty clay loam, light yellowish brown (10YR 6/4) when dry; coarse brownish-yellow (10YR 6/6) mottles and few coarse gray silt coats in lower part; moderate, medium, subangular blocky structure; hard, friable; about 30 percent chert by volume; continuous thin clay films; strongly acid; gradual, smooth boundary; horizon 5 to 12 inches thick.

Bx—22 to 30 inches, mottled yellowish-brown, gray, and strong-brown cherty silty clay loam; moderate, coarse, subangular blocky structure; hard, firm; about 30 percent chert, by volume; clay films on peds and chert fragments; very strongly acid; clear, smooth boundary; horizon 4 to 12 inches thick.

B3—30 to 42 inches, mottled gray, yellowish-brown, and strong-brown cherty silty clay loam; weak, subangular blocky structure; hard, firm; about 45 percent chert, by volume; clay films; very strongly acid.

Color of the A1 horizon is 10YR in hue, 4 or 5 in value, and 2 or 3 in chroma. The A2 horizon is 10YR in hue, 5 or 6 in value, and 2 or 3 in chroma. The chert content of these two horizons ranges from 15 to 30 percent, by volume.

The B1 horizon is 7.5YR or 10YR in hue, 4 or 5 in value, and 3 to 6 in chroma. The B2t horizon is 7.5YR or 10YR in hue, 4 or 5 in value, and 3 to 8 in chroma. In the B2t horizon, the content of chert ranges from 20 to 35 percent, by volume, and the content of clay ranges from 28 to 35 percent. Reaction ranges from strongly acid to very strongly acid. The Bx horizon is weakly to moderately developed. In some places very cherty horizons that are more than 50 percent chert, by volume, occur below a depth of 30 inches.

These Locust soils have less cherty A and B horizons (less than 35 percent chert) than the Clarksville soils. The B2 horizon of Locust soils is coarser textured than that of the Baxter and is more cherty than that of Stigler soils.

Locust cherty silt loam, 1 to 3 percent slopes (LoB).—This deep, cherty soil occurs on timbered uplands in cherty limestone areas. The profile is the one described as typical for the series.

Included with this soil in mapping are areas of Clarksville very cherty silt loam, totaling less than 4 percent of the acreage mapped; of Captina silt loam, totaling less than 5 percent; of Sallisaw gravelly silt loam, totaling less than 2 percent; and of Baxter cherty silt loam, totaling less than 4 percent. Also included are soils without a fragipan or soils that have very cherty material in the lower part of the B2 horizon.

This soil is used mostly for tame pastures. A small acreage is in small grains, sorghums, vegetables, orchards, and native hardwoods.

This soil is difficult to till because of the chert in the surface layer, but this chert reduces water erosion. Additions of fertilizer increase crop residue, and this residue helps to reduce erosion and to improve soil structure and fertility as well. Tame pasture also helps to control erosion if it is fertilized and sprayed or mowed to eliminate brush. (Capability unit IIIs-1; Smooth Chert Savannah range site; woodland suitability group 3)

Newtonia Series

The Newtonia series consists of deep, nearly level to gently sloping soils that have a thick, medium-textured surface layer over a moderately fine textured subsoil. These soils developed in cherty, loamy material that weathered from limestone on prairie uplands. Newtonia soils occupy sizable areas in the two counties. The native vegetation is mostly little bluestem, big bluestem, indiangrass, and switchgrass.

In a typical profile the upper part of the surface layer is dark reddish-brown silt loam about 10 inches thick. It is very friable when moist and is medium acid. The lower part of the surface layer is similar to the upper part but

is slightly more clayey. The subsoil is about 44 inches thick. It is medium acid, reddish-brown silty clay loam in the upper part; dark-red silty clay loam in the middle; and dark-red, strongly acid cherty silty clay loam in the lower part. The lower part is about 30 percent chert, by volume.

The Newtonia soils are well drained and have moderate permeability. They contain a large amount of organic matter, are easily tilled, and are generally well suited to crops. Available moisture capacity and natural fertility are good, but crop growth can be increased by adding lime and fertilizer.

The Newtonia soils are mainly used for field crops and tame grasses.

Typical profile of Newtonia silt loam, 0 to 1 percent slopes, about 1,320 feet east and 330 feet south of the northwest corner of section 2, T. 22 N., R. 25 E.:

A1—0 to 10 inches, dark reddish-brown (5YR 3/3) silt loam, reddish brown (5YR 5/3) when dry; moderate, medium and fine, granular structure; slightly hard, very friable; medium acid; gradual, smooth boundary; horizon 8 to 14 inches thick.

A3—10 to 16 inches, dark reddish-brown (5YR 3/3) heavy silt loam, reddish brown (5YR 5/3) when dry; moderate, fine, granular structure; slightly hard, friable; medium acid; gradual, smooth boundary; horizon 4 to 8 inches thick.

B21t—16 to 26 inches, reddish-brown (5YR 4/4) silty clay loam, reddish brown (5YR 5/4) when dry; moderate, medium, subangular blocky structure; hard, friable; clay films on ped surfaces; medium acid; gradual, smooth boundary; horizon 8 to 14 inches thick.

B22t—26 to 54 inches, dark-red (2.5YR 3/6) silty clay loam, red (2.5YR 5/6) when dry; moderate, coarse, subangular blocky structure; very hard, firm; clay films; few chert fragments; strongly acid; gradual, smooth boundary; horizon 12 to 24 inches thick.

B3—54 to 60 inches, dark-red (2.5YR 3/6) cherty silty clay loam, red (2.5YR 5/6) when dry; weak, medium, subangular blocky structure; hard, friable; about 30 percent chert, by volume; clay films; strongly acid.

Color of the A1 horizon is 10YR to 5YR in hue, less than 3.5 in value, and 2 or 3 in chroma. The B2t horizon is 5YR or 2.5YR in hue, 3 or 4 in value, and ranges from 3 to 6 in chroma. Below a depth of 24 inches, it ranges from silty clay loam to silty clay. Reaction ranges from medium acid to strongly acid. Depth to limestone is 72 inches or more.

The Newtonia soils have a thicker A1 horizon than that in the Baxter and Sallisaw soils. The B horizons in the Newtonia soils are more reddish than those in the Dennis, Summit, and Okemah soils.

Newtonia silt loam, 0 to 1 percent slopes (NaA).—This deep, dark soil occurs on prairie uplands. The profile is the one described as typical for the series.

Included with this soil in mapping are similar soils that have a lighter colored surface layer and total less than 2 percent of the acreage mapped. Also included are areas of Okemah silt loam and Newtonia silt loam that are on slopes of 1 to 3 percent and that total less than 8 percent of the acreage mapped.

This soil is used mostly for small grains, corn, sorghums, soybeans, and tame pasture. A small acreage is in prairie grasses.

The soil is well suited to crops, but crop growth can be increased by adding fertilizer and practicing good management. For maintaining soil structure and fertility, a large amount of crop residue is needed in cultivated areas. (Capability unit I–2; Loamy Prairie range site; woodland suitability group, none)

Newtonia silt loam, 1 to 3 percent slopes (NaB).—This deep soil occurs on uplands in prairie areas. The profile is similar to the one described as typical for the series. The dark-brown silt loam surface layer grades to dark reddish brown in the lower part and is about 16 inches thick. The red subsoil is a silty clay loam that is finer textured below a depth of 28 inches than it is above.

Included with this soil in mapping are areas of soils similar to this Newtonia soil that have a lighter colored surface layer and occupy 5 percent of the mapped acreage. Also included are areas of Dennis silt loam, Okemah silty clay loam, and Newtonia silt loam, 0 to 1 percent slopes, that total less than 5 percent of the acreage mapped.

This soil is used mostly for small grains, corn, sorghums, soybeans, and tame pasture (fig. 14). Prairie grasses occur in scattered small areas.

Cultivated areas of this soil are subject to erosion. Additions of fertilizer increase crop residue, and this residue helps to control erosion and improves fertility and soil structure as well. On long slopes, terraces, waterways, and contour farming help control loss of soil. The growth of tame pasture is increased if management is good and fertilizer is added. (Capability unit IIe–1; Loamy Prairie range site; woodland suitability group, none)

Newtonia silt loam, 3 to 5 percent slopes (NaC).—This deep soil occurs on upland prairies. It has a very dark grayish-brown silt loam surface layer over a yellowish-red silty clay loam subsoil that is similar to the surface layer and subsoil in the profile described as typical for the series.

Included with this soil in mapping are areas of Sallisaw silt loam, totaling less than 2 percent of the acreage mapped, and of Clarksville soils, totaling less than 5 percent. A soil similar to this Newtonia silt loam, but having a thinner surface layer, occupies about 8 percent of the acreage mapped.

This Newtonia soil is used mostly for tame pasture, small grains, sorghums, and soybeans. Small areas are in native grass.

This soil is subject to erosion where it is cultivated and not protected by terraces and contour farming. Adding fertilizer so as to increase crop residue for return to the surface layer improves soil structure, increases water intake, and reduces soil loss. An effective way of controlling erosion is keeping this soil in tame pasture plants or native grasses and using good management. (Capability unit IIIe–1; Loamy Prairie range site; woodland suitability group, none)

Newtonia silt loam, 2 to 5 percent slopes, eroded (NaC2).—This deep soil occurs on prairie uplands. It has a thinner surface layer than the soil described as typical for the series. Rills about 50 to 100 feet apart are numerous, and there are a few crossable gullies. Plowing has mixed the surface layer and subsoil in more than half of the acreage.

The surface layer is a very dark grayish-brown silt loam about 6 inches thick. The color and texture of the upper part of the subsoil are intermediate between color and texture of the surface layer and lower part of the subsoil. Below a depth of 19 inches, the lower part of the subsoil consists of yellowish-red silty clay loam.

All of this soil has been cultivated, but much of the acreage is now in bermudagrass, fescue, bromegrass, and

Figure 14.—**Corn on Newtonia silt loam, 1 to 3 percent slopes.**

clover. It is fairly well suited to crops in protected and well-managed fields.

Soil loss from erosion is lessened by using terraces and contour farming and by adding fertilizer so as to increase the amount of crop residue. Returning crop residue to the soil improves tilth, increases intake of water, increases productivity, and helps reduce erosion. A good way to control erosion is to keep this soil in tame and native grasses. (Capability unit IIIe-3; Loamy Prairie range site; woodland suitability group, none)

Okemah Series

The Okemah series consists of deep, nearly level to gently sloping soils that have a medium-textured and moderately fine textured surface layer over a moderately fine or fine-textured subsoil. These soils formed in material weathered mostly from shale and partly from sandstone on prairie uplands. The native vegetation is mostly big bluestem, little bluestem, indiangrass, and switchgrass.

In a typical profile the surface layer is black silty clay loam about 11 inches thick. It is friable when moist and is medium acid. The subsoil extends to a depth of 60 inches or more. The upper part is about 9 inches thick and consists of very dark grayish-brown silty clay loam. This layer is firm when moist and medium acid. Mottling begins in the upper part of the subsoil. The next layer is medium acid, olive-brown silty clay that is very firm when moist. The lower part of the subsoil, at a depth of about 40 inches, is mottled olive-brown and very dark gray, very firm silty clay.

The Okemah soils are moderately well drained and have slow permeability. They are easy to till in most places and contain a large amount of organic matter. Natural fertility is good, but crops respond to additions of lime and fertilizer.

These soils are used mostly for cultivated crops, but a few areas are in native and tame grasses.

Typical profile of Okemah silty clay loam, 1 to 3 percent slopes, about 1,050 feet south and 150 feet east of the northwest corner of section 31, T. 17 N., R. 22 E.:

A1—0 to 11 inches, black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) when dry; moderate, medium, granular structure; hard, friable; medium acid; gradual, smooth boundary; horizon 8 to 14 inches thick.

B1—11 to 20 inches, very dark grayish-brown (2.5Y 3/2) silty clay loam, dark grayish brown (2.5Y 4/2) when dry; few, fine, distinct mottles of brownish yellow; weak, medium, angular blocky structure; very hard, firm; few vertical cracks filled with black material; few, fine, black concretions; medium acid; gradual, smooth boundary; horizon 7 to 11 inches thick.

B2t—20 to 40 inches, olive-brown (2.5Y 4/3) silty clay; few, fine, distinct mottles of brownish yellow, light olive brown, and grayish brown; moderate, medium, angular blocky structure; extremely hard, very firm; thin continuous clay films; few vertical cracks filled with black material; few, fine, black concretions; medium acid; gradual, smooth boundary; horizon 20 to 36 inches thick.

B3—40 to 60 inches, mottled olive-brown (2.5Y 4/4) and very dark gray (2.5Y 3/1) silty clay; weak, fine and medium, angular blocky structure; extremely hard, very firm; moderately alkaline.

The A horizon ranges from very dark grayish brown to black in color. Color of the B1 horizon is 2.5Y and 10YR in hue, 2 to 5 in value, and 1 to 4 in chroma. The B2t horizon ranges from 7.5YR to 2.5YR in hue, 2 to 5 in value, and 1 to 6 in chroma. In texture the B2t ranges from silty clay loam to silty clay. Content of clay ranges from 35 to 45 percent. Grayish mottles occur in the upper 20 inches of the B horizon.

The B3 horizon has textures and colors similar to the B2t horizon, but is slightly acid to moderately alkaline in reaction.

The Okemah soils have a more clayey B2t horizon than the Bates and Choteau soils and a more brownish B2t horizon than Newtonia soils. The A horizon is thicker in the Okemah soils than in the Summit, and the change in texture between the A horizon and the B2t horizon is more gradual than in the Taloka, Parsons, and Woodson soils. The Okemah soils are similar to the Dennis soils, which do not have grayish mottles in the upper 20 inches of the B horizon.

Okemah silt loam, 0 to 1 percent slopes (OeA).—This deep soil occupies prairie uplands in Delaware County. The profile is similar to the one described as typical for the series. The surface layer, however, is very dark grayish-brown silt loam about 16 inches thick and is underlain by a silty clay loam subsoil that has gray mottles at a depth of about 35 inches.

Included with this soil in mapping are areas of Okemah silty clay loam, totaling less than 3 percent of the acreage mapped; of Parsons silt loam, totaling less than 6 percent; and of Dennis silt loam, totaling less than 10 percent.

This Okemah silt loam is used for small grains, corn, sorghums, soybeans, and tame pasture. A small acreage is in native grass.

This soil is well suited to crops, but growth of crops can be increased by good management that provides addition of fertilizer. Loss of soil can be lessened by returning large amounts of crop residue, which also improves soil structure and fertility. (Capability unit I–2; Loamy Prairie range site; woodland suitability group, none)

Okemah silty clay loam, 0 to 1 percent slopes (OkA).—This deep, dark-colored soil occurs on prairie uplands, mostly in Cherokee County. It has a very dark gray silty clay loam surface layer over a very dark brown subsoil that is silty clay loam in the upper part and is silty clay in the lower part. This subsoil is similar to the one in the profile described as typical for the series.

Included with this soil in mapping are areas of Dennis silt loam, Woodson silt loam, and Parsons silt loam that together make up less than 7 percent of the mapped acreage.

Most of this soil is cultivated or in tame pasture. Wheat is the main crop; but corn, oats, grain sorghum, and soybeans are also grown. Managing this soil is not difficult. Crops grow well when good farming methods are used. Adding fertilizer increases growth of crops and furnishes large amounts of crop residue that improve soil structure and fertility. (Capability unit I–2; Loamy Prairie range site; woodland suitability group, none)

Okemah silty clay loam, 1 to 3 percent slopes (OkB).—This deep soil occupies prairie uplands. The profile is the one described as typical for the series.

Included with this soil in mapping are small areas of Okemah silty clay loam, 0 to 1 percent slopes, and small areas of eroded soils similar to Okemah soils but having a thinner surface layer.

Wheat, corn, grain sorghum, soybeans, and tame pasture are grown on a large part of this soil. Some small areas are in native grasses.

Producing large amounts of crop residue by adding fertilizer helps to prevent erosion and to improve structure and fertility. On long slopes and in eroded areas, terraces, waterways, and contour farming are also needed to control erosion adequately. (Capability unit IIe–1; Loamy Prairie range site; woodland suitability group, none)

Okemah silty clay loam, 3 to 5 percent slopes (OkC).—This deep soil occurs on prairie uplands in Cherokee County. It has a black silty clay loam surface layer over a subsoil that is very dark brown silty clay loam in the upper part and is silty clay at a depth of 37 inches.

Included with this soil in mapping are areas of Summit silty clay loam, 2 to 5 percent slopes, eroded, and small areas of Okemah silty clay loam, 1 to 3 percent slopes. These included areas make up less than 10 percent of the mapped acreage.

About half of this soil is used for tame pastures and only a small area is in native grass. Wheat and grain sorghum are the most commonly cultivated crops.

Because this soil is subject to severe erosion, practices that help prevent loss of soil and that improve soil structure and fertility are needed. Practices of this kind are returning crop residue to the soil, terracing, contour farming, growing and plowing under green-manure crops, and adding fertilizer. A good way to control erosion is growing tame pasture plants and native grasses. (Capability unit IIIe–4; Loamy Prairie range site; woodland suitability group, none)

Osage Series

The Osage series consists of deep, nearly level soils that are fine textured. These soils occupy small areas in Cherokee County. They developed in clayey alluvium on flood plains and terraces. The native vegetation is oak, hickory, hackberry, elm, and some pine trees and an understory consisting mainly of little bluestem and big bluestem grasses.

In a typical profile clay extends from the surface to a depth of 60 inches or more. The top 11 inches is black, firm when moist, and neutral. Below this is 13 inches of black clay that is very firm when moist and has a few, fine, yellowish-brown mottles and a few, fine, yellowish-red, soft concretions of iron. At about a depth of 24 inches is very dark gray clay that has common, medium mottles of strong brown and yellowish red. Below a depth of 36 inches, colors are lighter. This lower part is very firm when moist, is mildly alkaline, and contains a few concretions of soft iron and hard manganese.

The Osage soils have very slow permeability and very slow runoff and are somewhat poorly drained. These clayey soils are wet for long periods, and they shrink and crack when dry. Organic-matter content and natural fertility are high, but additions of lime and fertilizer increase crop production.

The Osage soils are used mostly for tame grass, but some areas produce field crops and timber.

Typical profile of Osage clay, about 2,400 feet west and 2,400 feet south of the northeast corner of section 26, T. 17 N., R. 21 E.:

A11—0 to 11 inches, black (10YR 2/1) light clay, very dark gray (10YR 3/1) when dry; moderate, fine and medium, granular structure; very hard, firm; neutral; gradual, smooth boundary; horizon 7 to 16 inches thick.

A12—11 to 24 inches, black (10YR 2/1) clay, very dark gray (10YR 3/1) when dry; few, fine, distinct, yellowish-brown mottles; strong, medium, blocky structure; extremely hard, very firm; shiny ped surfaces; material

from upper horizon in many cracks, pores, and root channels; few, fine, yellowish-red, soft concretions of iron; neutral; gradual, smooth boundary; horizon 10 to 20 inches thick.

A13—24 to 36 inches, very dark gray (10YR 3/1) light clay, dark gray (10YR 4/1) when dry; common, medium, prominent mottles of strong brown (7.5YR 5/6) to yellowish red (5YR 5/6); strong, medium, blocky structure; extremely hard, very firm; shiny ped surfaces; material from upper horizons in some pores, cracks, and root channels; few, very fine fragments of chert; few, strong-brown and yellowish-red, soft concretions of iron; few, black, hard concretions of manganese; few slickensides not close enough to intersect in lower part of horizon; neutral; gradual, smooth boundary; horizon 8 to 18 inches thick.

A14—36 to 60 inches, dark-gray (10YR 4/1) light clay, about 30 percent of which has medium, distinct, reddish-yellow (7.5YR 6/6) and strong-brown (7.5YR 5/6) mottles; gray (10YR 5/1) when dry; moderate, medium, blocky structure; extremely hard, very firm, shiny ped surfaces; few fragments of chert; few strong-brown and yellowish-red soft concretions of iron; few, fine, slightly hard, black concretions of manganese; some organic stains in root channels; few slickensides not close enough to intersect; mildly alkaline.

The color of the A11 horizon is 10YR in hue, 2 or 3 in value, and 1 or 2 in chroma. This horizon is light clay or clay in most places, but in some places it ranges to heavy silty clay loam that is more than 35 percent clay. The A12 horizon is similar to the A11 horizon in color and in some places lacks mottles in the upper part. Texture is clay in most places, but in some places it ranges to silty clay and heavy silty clay loam that is more than 35 percent clay. The proportion of clay increases less than 8 percent within 12 inches vertical distance of the upper horizon. Reaction ranges from slightly acid to mildly alkaline. Color of the A14 horizon is 10YR or 2.5YR in hue, 3 to 5 in value, and 1 or 2 in chroma. In texture and reaction, the A14 horizon is similar to the A12.

Osage soils are more clayey than the Verdigris soils but lack the clay-enriched horizon of the Woodson soils.

Osage clay (0 to 1 percent slopes) (Os).—This deep, clayey soil occurs on flood plains and terraces along timbered streams. Flooding is occasional. The profile is the one described as typical for the series.

Included with this soil in mapping are small areas of soils similar to this Osage soil, but the included soils have clay-enriched horizons. They total less than 3 percent of the acreage mapped. Also included are areas of Verdigris silt loam, totaling less than 5 percent.

Osage clay is used mostly for tame pasture grasses and legumes, but some areas are in timber. If adequately drained, this soil is poorly suited to moderately well suited to wheat and grain sorghum.

Use of this soil is limited mainly by the content of clay and susceptibility to flooding. Because this soil is somewhat poorly drained and is wet on the surface, drainage ditches are commonly needed for good growth of tame pasture plants and crops. Because the period of effective tillage is short on this soil, efficient use must be made of time and equipment. The structure of the surface layer and available moisture capacity can be improved by adding fertilizer to obtain maximum amounts of crop residue, adding animal manure, and planting green-manure crops.

In areas not in timber, a good use is tame pasture. Care must be taken, however, to graze the pasture only when it is dry and when grazing is necessary to prevent return of brush. (Capability unit IIIw-1; Heavy Bottomland range site; woodland suitability group 1)

Parsons Series

The Parsons series consists of deep, nearly level soils that have a medium-textured surface layer and a moderately fine textured or fine-textured subsoil (fig. 15). These soils developed in clayey alluvium in prairie areas. Native vegetation is mainly little bluestem, big bluestem, indiangrass, and switchgrass.

In a typical profile the surface layer is very dark grayish-brown silt loam about 10 inches thick. It is very friable and strongly acid. The next layer is grayish-brown silt loam about 2 inches thick. The subsoil, to a depth of 39 inches, is dark grayish-brown and brown clay that is mottled with reddish yellow. This layer is very firm when moist and is medium acid in the upper part and neutral in the lower part. At a depth of 39 inches, the subsoil is gray silty clay loam that is mottled with strong brown. This layer is very firm when moist and is mildly alkaline.

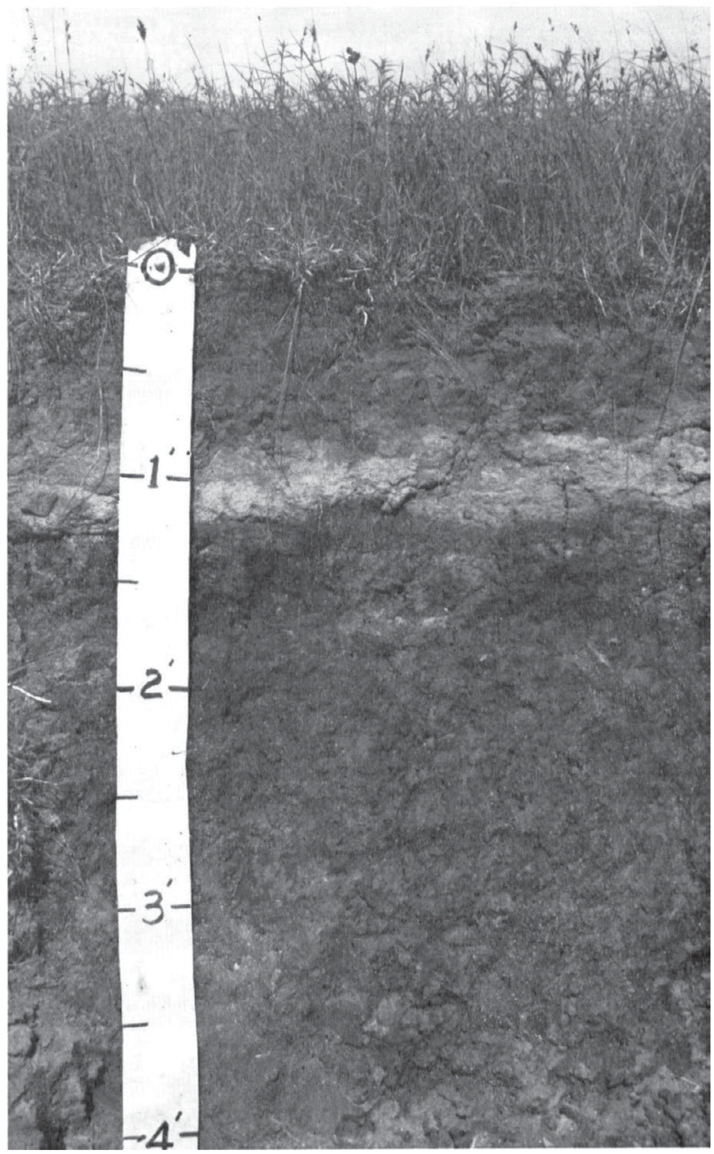

Figure 15.—Typical profile of Parsons silt loam, 0 to 1 percent slopes, in an area of native grass.

The Parsons soils are somewhat poorly drained because the subsoil is very slowly permeable. Surface wetness delays tillage for short periods after rains. These soils have medium fertility, and they respond to additions of lime and fertilizer.

Most of the acreage is used for small grains, but some areas are in tame grasses.

Typical profile of Parsons silt loam, about 1,040 feet east and 60 feet north of the southwest corner of section 29, T. 25 N., R. 22 E.:

Ap—0 to 10 inches, very dark grayish-brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) when dry; few, fine, faint, dark-brown mottles; moderate, fine, granular structure; slightly hard, very friable; strongly acid; gradual, smooth boundary; horizon 8 to 12 inches thick.

A2—10 to 12 inches, grayish-brown (10YR 5/2) silt loam, light brownish gray (10YR 6/2) when dry; few, fine, faint mottles of dark brown; weak, medium, granular structure; slightly hard, very friable; strongly acid; abrupt, smooth boundary; horizon 3 to 7 inches thick.

B21t—12 to 29 inches, dark grayish-brown (10YR 4/2) clay, grayish brown (10YR 5/2) when dry; common, medium, distinct mottles of reddish yellow; moderate, coarse, blocky structure; very hard, very firm; clay films; medium acid; gradual, smooth boundary; horizon 14 to 24 inches thick.

B22t—29 to 39 inches, brown (10YR 5/3) clay, pale brown (10 YR 6/3) when dry; few fine and common medium, distinct mottles of reddish yellow (7.5YR 6/6); moderate, coarse, blocky structure; very hard, very firm; clay films; common, fine gypsum crystals; neutral; gradual boundary; horizon 6 to 20 inches thick.

B3—39 to 60 inches, gray (10YR 5/1) silty clay loam, light gray (10YR 7/1) when dry; few, fine, distinct mottles of strong brown (7.5YR 5/6); weak, coarse, blocky structure; very hard, very firm; mildly alkaline.

Color of the Ap horizon is 10YR in hue, less than 3.5 in value, and 2 or 3 in chroma. The A2 horizon is 10YR in hue, 5 or 6 in value, and 1 or 2 in chroma. The A2 horizon grades to the B2t horizon within a vertical distance of 3 inches. Total thickness of the A horizons is less than 16 inches.

The B21t horizon ranges from 10YR to 5Y in hue, 3 to 5 in value, and 1 or 2 in chroma. Reddish, yellowish, and brownish mottles occupy from 10 to 40 percent of the soil mass. The B21t horizon is 38 to 55 percent clay and is strongly acid to neutral. The B3 horizon is 10YR or 2.5Y in hue, 4 or 5 in value, and 1 to 4 in chroma. Reaction ranges from slightly acid to mildly alkaline.

The Parsons soils have a finer textured B horizon than have the Newtonia and Choteau soils and a less thick A horizon than the Taloka soils. The change in texture between the A and B horizons in the Parsons soils is more abrupt than the change between those horizons in the Dennis and Summit soils. Parsons soils have an A2 horizon, but typically the Woodson soils do not.

Parsons silt loam, 0 to 1 percent slopes (PaA).—This deep soil occupies prairie uplands in Delaware County. The profile is the one described as typical for the series.

Included with this soil in mapping are soils that are similar to this soil but that have a more yellowish colored subsoil. These included soils make up less than 5 percent of the acreage mapped. Also included are areas of Taloka silt loam, totaling less than 6 percent, and of Okemah silt loam, totaling less than 2 percent. A few small areas are eroded.

Wheat, grain sorghum, and tame pastures are the main crops on this Parsons soil. A few small areas are in native grass.

Because the clayey subsoil is very slowly permeable, this soil is somewhat poorly drained and subject to seasonal wetness and droughtiness. It has good available moisture capacity, but the slow intake of water causes wetness on the more nearly level slopes and causes runoff and erosion on slopes of about 1 percent. On long slopes, terraces may be needed. In flat and slightly depressional areas, surface drainage is needed to reduce crop loss. Large amounts of crop residue obtained by adding fertilizer or manure are especially beneficial to this soil because these additions improve soil structure, increase intake of water, and increase permeability. (Capability unit IIs-1; Claypan Prairie range site; woodland suitability group, none)

Rough Stony Land

Rough stony land (Rs) consists of very steep, stony breaks that have some vertical cliffs and ledges. This land type occurs along the Grand River in the western part of Cherokee County. Slopes range from 40 to 100 percent. Rock outcrops occupy 40 to 50 percent of this land, and among them are mixed residual and colluvial soils that are less than 10 inches deep over sandstone and occupy 30 to 40 percent of the area. In 10 percent of this land, there are small, scattered areas where about 20 inches of colluvium has accumulated. The soil material ranges from loam to fine sandy loam and has many fine and coarse fragments of standstone.

Rough stony land supports hardwoods of low quality, brush, and scattered thin stands of native grasses. This land is used mainly for woodland pasture and wildlife food and cover, but use for grazing is limited because many areas are not accessible to livestock. Because this land is subject to very severe erosion, careful management of range is needed. (Capability unit VIIs-4; Breaks range site; woodland suitability group, none)

Sallisaw Series

The Sallisaw series consists of deep, very gently sloping to sloping soils that have a gravelly or medium-textured surface layer and a gravelly or moderately fine textured subsoil. These soils developed in loamy alluvium on benches along the major streams. The native vegetation consists mainly of oak and pine and an understory of little bluestem, big bluestem, indiangrass, and switchgrass.

In a typical profile the surface layer is dark-brown silt loam about 9 inches thick. It is about 15 percent gravel, is friable when moist, and is slightly acid. The subsoil is strong brown, friable, and strongly acid. It has an upper layer of silt loam or silty clay loam that is about 20 percent gravel. At a depth of about 32 inches is very gravelly silty clay loam that is about 75 percent gravel.

These well-drained soils have moderate permeability. The gravelly soils are somewhat difficult to till, but when fertilized and well managed, they are moderately well suited or well suited to crops. The high content of chert in the subsoil limits the amount of moisture available for plant use.

The Sallisaw soils are used mostly for tame pastures and field crops.

Typical profile of Sallisaw gravelly silt loam, 1 to 3 percent slopes, about 1,000 feet east and 100 feet south of the northwest corner of section 36, T. 17 N., R. 22 E.:

Ap—0 to 9 inches, dark-brown (10YR 4/3) gravelly silt loam, pale brown (10YR 6/3) when dry; moderate, fine, granular structure; slightly hard, friable; about 15 percent gravel; slightly acid; gradual, smooth boundary; horizon 7 to 14 inches thick.

B1—9 to 18 inches, strong-brown (7.5YR 5/6) gravelly heavy silt loam, reddish yellow (7.5YR 7/6) when dry; moderate, fine and medium, subangular blocky structure; hard, friable; about 15 percent gravel; strongly acid; gradual, wavy boundary; horizon 5 to 10 inches thick.

B21t—18 to 32 inches, strong-brown (7.5YR 4/6) gravelly light silty clay loam, reddish yellow (7.5YR 6/6) when dry; moderate, medium, subangular blocky structure; hard, friable; continuous clay films; about 20 percent gravel in upper part and 35 percent in lower part; strongly acid; gradual, wavy boundary; horizon 8 to 24 inches thick.

IIB22t—32 to 63 inches, strong-brown (7.5YR 5/6) very gravelly silty clay loam, reddish yellow (7.5YR 6/6) when dry; weak, medium, subangular blocky structure; hard, friable; about 75 percent gravel; thin clay films; strongly acid.

Colors of the A horizon are 7.5YR or 10YR in hue, 4 or 5 in value, and 2 to 4 in chroma. The A horizon is from 5 to 30 percent gravel.

Colors of the B2t horizon range from 7.5YR to 2.5YR in hue, 4 to 5 in value, and 4 to 8 in chroma. The B2t horizon is 22 to 35 percent clay, 5 to 35 percent gravel, and more than 15 percent material coarser than very fine sand. Depth to the very gravelly substratum ranges from 30 to 60 inches. The B horizon and lower horizons range from medium to strongly acid.

The Sallisaw soils have a more clayey subsoil than the Staser soils, have a less clayey B2t horizon than the Baxter soils, and lack the thick dark A horizon of the Newtonia soils.

Sallisaw gravelly silt loam, 1 to 3 percent slopes (SgB).—This deep, loamy soil occurs on forested benches along streams. Its profile is the one described as typical for the series.

Included with this soil in mapping are areas of Sallisaw silt loam, totaling less than 11 percent of the acreage mapped; similar soils with a very dark grayish-brown surface layer, totaling less than 3 percent; and similar soils without very gravelly underlying material, totaling less than 2 percent.

Most of the acreage is in small grains, sorghums, soybeans, and tame pastures. Some areas are in native hardwoods and grass.

Where cultivated, this soil is subject to moderate erosion. Terraces, contour farming, and good management of crop residue help to control erosion and to improve soil structure and fertility. Brush needs to be controlled on tame pastures. Trees grow well if they are protected from fire and well managed. (Capability unit IIe–2; Smooth Chert Savannah range site; woodland suitability group 3)

Sallisaw gravelly silt loam, 3 to 8 percent slopes (SgD).—This deep, loamy soil occurs on benches along streams in forested areas. It has a dark grayish-brown gravelly silt loam surface layer and a yellowish-red gravelly silty clay loam subsoil.

Included with this soil in mapping are Clarksville soils, totaling less than 5 percent of the acreage mapped, and Sallisaw silt loam, totaling less than 4 percent. Also included are soils with a yellowish-brown subsoil that are similar to this gravelly soil and total about 6 percent, similar soils with slopes of more than 8 percent, totaling less than 2 percent, and eroded soils, totaling about 3 percent.

The main crops are tame pasture grasses. Small grain, sorghums, strawberries, and vegetables are grown in some areas. Hardwood and pine trees grow in a small acreage.

Where this soil is used for tame pasture, the pasture must be mowed or sprayed to prevent it from reverting to brush. Fire control and good management are essential to the good growth of trees.

If this soil is cropped and not protected, it is subject to very severe erosion. Use of large amounts of crop residue, cover crops, and contour tillage help to control soil loss and to improve soil structure and fertility. In many places upper slopes are terraced to divert water that runs off from the higher and steeper adjoining Clarksville soils, but slopes and the very gravelly subsoil make terraces difficult to construct. (Capability unit IVe–1; Smooth Chert Savannah range site; woodland suitability group 3)

Sallisaw silt loam, 0 to 1 percent slopes (SaA).—This deep, loamy soil occurs on forested benches along streams. It has a dark yellowish-brown silt loam surface layer and a yellowish-red silty clay loam subsoil, both containing less gravel than corresponding layers in the profile described as typical for the series.

Included with this soil in mapping are areas of Sallisaw gravelly silt loam, totaling less than 5 percent of the acreage mapped; of Sallisaw silt loam, 1 to 3 percent slopes, totaling less than 2 percent; of similar soils with a very dark grayish-brown surface layer, totaling less than 8 percent; and of similar soils with very gravelly underlying material, totaling less than 5 percent.

This soil is used mostly for small grains, corn, sorghums, orchard trees, vegetables, and tame pasture. A small acreage is in timber.

Crop residue returned to the surface layer improves soil structure and fertility. Tame pastures need to be mowed or sprayed to keep them from reverting to brush. Under good management this soil is very well suited to hardwoods and pines. (Capability unit I–1; Smooth Chert Savannah range site; woodland suitability group 2)

Sallisaw silt loam, 1 to 3 percent slopes (SaB).—This deep, loamy soil occupies forested benches along streams. It has a dark-brown silt loam surface layer and a yellowish-red light silty clay loam subsoil, both containing less gravel than corresponding layers in the profile described as typical for the series.

Included in mapping are areas of more nearly level Sallisaw silt loam, totaling less than 5 percent, and Sallisaw gravelly silt loam, totaling less than 4 percent. In other included areas are soils with a very dark grayish-brown surface layer, totaling less than 3 percent, and soils with very gravelly layers, totaling less than 3 percent.

This soil is used mainly for tame pastures and cultivated crops. Hardwood and pine trees grow in some areas.

Additions of fertilizer and control of grazing and brush are required for maximum growth of tame grasses. If fire is controlled and undesirable trees are removed, this soil is suited to hardwoods and pines. Adding fertilizer for maximum crop residue and using terraces and contour farming are ways of controlling loss of soil and preserving soil structure and fertility. (Capability unit IIe–2; Smooth Chert Savannah range site; woodland suitability group 2)

Staser Series

The Staser series consists of nearly level to very gently sloping soils that have a gravelly and medium-textured surface layer and subsoil (fig. 16). These soils developed in gravelly and loamy alluvium on flood plains. Flooding is occasional. Under natural conditions, these soils support sycamore, oak, elm, hickory, walnut, and maple tree and native grass.

Figure 16.—Profile of Staser gravelly loam in which a very gravelly layer is at a depth of about 3 feet.

In a typical profile the surface layer, about 12 inches thick, is very dark grayish-brown gravelly loam that is about 17 percent gravel by volume. This layer is very friable and slightly acid. The subsoil is dark-brown gravelly loam that extends to a depth of 43 inches and is about 20 percent gravel by volume. It is friable when moist and is medium acid. The substratum is dark-brown very gravelly loam that is 70 percent gravel.

These well-drained soils are occasionally flooded and have moderately rapid permeability. Their natural fertility is high, but they are only moderately well suited to crops because their gravel content reduces the moisture available to the plants. Crops grow better on nongravelly soils.

These soils are used mostly for tame pastures, but small local areas are in cultivated crops. A sizable acreage remains in timber and grass.

Typical profile of Staser gravelly loam, about 2,380 feet east and 330 feet north of the southwest corner of section 18, T. 23 N., R. 24 E.:

A1—0 to 12 inches, very dark grayish-brown (10YR 3/2) gravelly loam, dark grayish brown (10YR 4/2) when dry; gravel about 17 percent of volume; moderate, medium, granular structure; soft, very friable; slightly acid; gradual, smooth boundary; horizon 8 to 18 inches thick.

B21—12 to 24 inches, dark-brown (10YR 4/3) gravelly heavy loam, pale brown (10YR 6/3) when dry; gravel about 20 percent of volume; weak, fine and medium, granular and subangular blocky structure; slightly hard, friable; medium acid; gradual, wavy boundary; horizon 10 to 20 inches thick.

B22—24 to 43 inches, dark-brown (7.5YR 4/4) gravelly loam, light brown (7.5YR 6/4) when dry; gravel about 40 percent of volume; weak, fine, granular and weak, medium, subangular blocky structure; slightly hard, friable; medium acid; gradual, wavy boundary; horizon 10 to 20 inches thick.

C—43 to 60 inches, dark-brown (10YR 4/3) very gravelly loam, brown (10YR 5/3) when dry; gravel about 70 percent of volume; slightly hard, friable; medium acid.

Color of the A horizon is 10YR in hue, 3 in value, and 2 or 3 in chroma. This horizon is gravelly loam in most places, but it ranges to gravelly silt loam and silt loam. Content of gravel ranges from about 0 to 30 percent by volume. The B horizon is 10YR or 7.5YR in hue, 3 or 4 in value, and 2 to 4 in chroma. In some areas where the B horizon is very dark grayish brown below a depth of 24 inches, the organic matter is less than 1 percent. The content of gravel ranges from 5 to 35 percent in the upper 30 inches of Staser soils. These soils range from medium acid to neutral in reaction.

The C horizon is 7.5YR or 10YR in hue, 4 or 5 in value, and 2 to 6 in chroma. In this horizon, content of gravel ranges from 15 to 35 percent above a depth of 40 inches and from 20 to 80 percent in the lower part.

The Staser soils have a darker, thicker A horizon and a less reddish B horizon than the Sallisaw soils. The content of gravel is less in the Staser soils than in the Elsah. Staser soils are similar to the Verdigris soils but have a thinner dark surface layer and more gravelly subsoil.

Staser gravelly loam (0 to 3 percent slopes) (Sn).—This deep loamy soil occupies flood plains and low benches in timbered areas. The profile is the one described as typical for the series.

Included with this soil in mapping are areas of Sallisaw silt loam, totaling about 3 percent of the acreage mapped, of Elsah soils, totaling about 8 percent, and of Staser silt loam, totaling about 12 percent.

This Staser soil is used mostly for tame pasture, but wheat, sorghums, corn, and soybeans are grown in small areas. There are also small areas of hardwood trees.

Because this soil is flooded occasionally, field crops may be lost if not protected. Large amounts of crop residue returned to the soil reduce soil loss and maintain fertility. Because this soil is flooded and is difficult to till, it is better suited to tame pasture than to cultivated crops. Protection from fire is needed for tame pasture and hardwoods. (Capability unit IIw-3; Loamy Bottomland range site; woodland suitabality group 1)

Staser silt loam (0 to 1 percent slopes) (Sm).—This deep, loamy soil occupies flood plains and low benches in timbered areas. It has a very dark grayish-brown silt loam surface layer over a dark-brown silt loam subsoil. These layers are similar to the surface layer and subsoil in the profile described as typical for the series, except that they contain less gravel. Flooding is occasional on this soil.

Included with this soil in mapping are areas of Sallisaw silt loam, totaling less than 2 percent of the acreage mapped; of Staser gravelly loam, totaling about 15 percent; and of Elsah soils, totaling about 2 percent. Also included are areas of soils similar to Staser silt loam, except that these included soils have gray mottles above a depth of 36 inches. They occupy about 6 percent of the mapped acreage.

This soil is used mostly for tame pastures, wheat, corn, sorghums, and soybeans. Alfalfa can be grown if lime and fertilizer are added. A few areas are in hardwood trees.

Field crops can be destroyed by the occasional floods, but damage to the soil is seldom extensive. In some areas pro-

tection from flooding is needed for maximum growth of crops or pasture. Additions of fertilizer increase crop growth and the amount of crop residue. This residue helps maintain soil structure and fertility. Seeding tame pasture is a good way to control loss of soil. (Capability unit IIw-1; Loamy Bottomland range site; woodland suitability group 1.

Stigler Series

The Stigler series consists of deep, nearly level soils that have a medium-textured surface layer and mainly a moderately fine textured subsoil. These soils developed in loamy and clayey alluvium over cherty limestone. They occur on uplands and high benches along some of the major streams in the two counties. The native vegetation is mostly oak and pine trees and an understory of little bluestem, big bluestem, indiangrass, and switchgrass.

In a typical profile the surface layer, about 12 inches thick, is silt loam that is dark grayish brown in the upper 6 inches and pale brown below. This layer is friable and, where unlimed, strongly acid. The subsoil is brown silt loam in the upper 6 inches. Below this is silty clay loam that is pale brown and mottled reddish brown and grayish brown to a depth of 37 inches and light brownish gray with yellowish-brown mottles below that depth. The subsoil is firm and very firm. It is strongly acid and very strongly acid in the upper part and slightly acid at a depth of 37 inches.

The Stigler soils are somewhat poorly drained and very slowly permeable. They have a small amount of organic matter in the surface layer but are well suited to most crops if properly fertilized and managed.

These soils are used mostly for tame pasture and, to a lesser degree, for cultivated crops.

Typical profile of Stigler silt loam, 0 to 1 percent slopes, about 650 feet east and 2,400 feet north of the southwest corner of section 27, T. 23 N., R. 24 E.:

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) when dry; weak, fine, granular structure; slightly hard, friable; strongly acid; clear, smooth boundary; horizon 2 to 8 inches thick.

A2—6 to 12 inches, pale-brown (10YR 6/3) silt loam, very pale brown (10YR 7/3) when dry; few, fine, prominent mottles of yellowish red (5YR 5/6); weak, fine, granular structure; hard, friable; few small concretions of manganese; strongly acid; clear, smooth boundary; horizon 4 to 16 inches thick.

B1—12 to 18 inches, brown (10YR 5/3) heavy silt loam, pale brown (10YR 6/3) when dry; common, medium, faint mottles of brownish yellow; moderate, medium, subangular blocky structure; hard, firm; strongly acid; abrupt, smooth boundary; horizon 3 to 8 inches thick.

B21t—18 to 23 inches, pale-brown (10YR 6/3) silty clay loam; common, fine, prominent mottles of reddish brown and common, fine, faint mottles of grayish brown; weak, thin, platy and moderate, fine, subangular blocky structure; very hard, very firm; clay films on peds; very strongly acid; clear, smooth boundary; horizon 1 to 6 inches thick.

B22t—23 to 37 inches, mottled yellowish-brown (10YR 5/6) and grayish-brown (10YR 5/2) silty clay loam; common, fine, prominent, red (2.5YR 5/6) mottles in upper part; moderate, medium and coarse, angular blocky structure; very hard, very firm; clay films on ped surfaces; very strongly acid; clear, smooth boundary; horizon 15 to 30 inches thick.

B23tg—37 to 65 inches, light brownish-gray (10YR 6/2) silty clay loam; many coarse, distinct mottles of yellowish brown (10YR 5/6); weak, coarse, subangular blocky structure; very hard, very firm; clay films; slightly acid; clear boundary; horizon 3 to 12 inches thick.

Color of the Ap horizon is 10YR in hue, 4 or 5 in value, and 2 or 3 in chroma. The A2 horizon is 10YR in hue, 5 or 6 in value, and 2 to 4 in chroma.

The B2t horizon ranges from 7.5YR to 2.5YR in hue, 4 to 6 in value, and 3 to 6 in chroma. Mottles of gray, grayish brown, and light gray occur within 30 inches of the surface. The B2t horizon is silty clay loam in the upper part but ranges from heavy silty clay loam to clay in the lower part. Content of clay ranges from 35 to 50 percent. Reaction of the B2t horizon ranges from very strongly acid to slightly acid. The B23tg horizon has colors that are similar to those of the B2t horizon but are grayer. The B23tg horizon ranges from slightly acid to mildly alkaline.

Grayish mottles occur in the upper part of the clay-enriched horizon of the Stigler soils but not in the Linker, Baxter, Sallisaw, and Captina soils. Stigler soils do not have a fragipan like that in the Captina soils, nor a reddish-colored B2t horizon like that in the Linker and Baxter soils.

Stigler silt loam, 0 to 1 percent slopes (SrA).—This deep soil occurs on uplands and high benches along streams in timbered areas. The profile is the one described as typical for the Stigler series.

Included with this soil in mapping are areas of Captina silt loam that make up about 6 percent of the acreage mapped. Also included are areas of a soil in slight depressions that has grayer B2t horizons than this Stigler soil. These included areas total about 8 percent of the mapped acreage.

This soil is used mostly for tame pasture, but some areas are in wheat, sorghums, soybeans, and native hardwoods.

Tame pasture is the most common use because this soil is often wet when it is time to plant or harvest field crops. Crop residue returned to the soil improves soil structure and water intake. Surface drainage is needed in slight depressions. Native hardwoods and pines grow well if they are protected from fire and the woodland is managed well. (Capability unit IIw-2; Smooth Chert Savannah range site; woodland suitability group 5)

Summit Series

The Summit series consists of deep, gently sloping soils that have a moderately fine textured surface layer and mainly a fine-textured subsoil. These soils swell when wet and shrink and crack when they dry. They developed over limestone on prairie uplands. The native vegetation is mostly little bluestem, big bluestem, indiangrass, and switchgrass.

In a typical profile the surface layer consists of black silty clay loam about 3 inches thick. It is firm when moist and is slightly acid.

The subsoil extends to a depth of about 48 inches. The upper part, about 14 inches thick, is very dark brown silty clay loam that is mottled with olive yellow and dark reddish brown. The lower part is olive-brown silty clay that is similarly mottled. The subsoil is very firm when moist and is moderately alkaline. It rests on limestone.

The Summit soils are moderately well drained and slowly permeable. They have a high content of organic matter.

These soils, except in eroded areas, are moderately well

suited to most field crops but are generally used for tame pastures.

Typical profile of Summit silty clay loam, 2 to 5 percent slopes, eroded, about 2,000 feet south of the northwest corner of section 11, T. 16 N., R. 20 E.:

A1—0 to 3 inches, black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) when dry; common, fine, faint, olive-yellow and reddish-brown mottles; strong, medium, granular structure; very hard, firm; few dark concretions; slightly acid; clear smooth boundary; horizon 2 to 6 inches thick.

B1—3 to 17 inches, very dark-brown (10YR 2/2) heavy silty clay loam, dark brown (10YR 4/3) when dry; common, fine, faint, olive-yellow and dark reddish-brown mottles; strong, medium, subangular blocky structure; very hard, firm; few vertical cracks filled with black material; few fine black concretions; continuous clay films; slightly acid; clear, smooth boundary; horizon 5 to 14 inches thick.

B2t—17 to 48 inches, olive-brown (2.5Y 3/4) silty clay, olive brown (2.5Y 4/4) when dry; same mottling as in the B1; strong, medium, subangular blocky structure; very hard, very firm; few vertical cracks; few slickensides in lower part; continuous clay films; few dark concretions; moderately alkaline; clear, irregular boundary; horizon 20 to 40 inches thick.

R—48 inches, limestone bedrock.

Color of the A1 horizon is 10YR in hue, 2 or 3 in value, and 1 or 2 in chroma. Texture is dominantly silty clay loam but ranges to light silty clay in the more eroded areas near small rills and gullies.

The B2 horizon is 10YR or 2.5Y in hue, 4 to 2 in value, and 2 to 4 in chroma. In most places reaction is slightly acid to moderately alkaline in the clay-enriched horizon. The B2t horizon is more than 35 percent clay and ranges from heavy silty clay loam to silty clay. Depth to limestone or interbedded clayey shale ranges from 40 inches to more than 6 feet.

The Summit soils have clay-enriched horizons that are generally more clayey than those in Dennis soils. Also, slickensides occur in the Summit soils, but not in the Dennis and Okemah. Summit soils are more clayey than the very shallow Talpa soils, which do not have clay-enriched horizons.

Summit silty clay loam, 2 to 5 percent slopes, eroded (SuC2).—This deep soil occurs on prairie uplands in Cherokee County. The profile is the one described as typical for the Summit series.

Included with this soil in mapping are areas of Okemah silty clay loam, totaling about 8 percent of the acreage mapped, and of Dennis silt loam, totaling about 3 percent. Inclusions of Talpa soils occupy the stronger slopes and make up about 1 percent of the acreage mapped.

This Summit soil is moderately eroded. In most fields the loss of soil is indicated by rills, common shallow gullies, a few deep gullies, and thin surface layers. Tillage has mixed the thin surface layer with the more clayey subsoil in about 60 percent of the area mapped. In places erosion has removed all of the surface layer and the subsoil is exposed.

Most of this soil is in tame pasture so as to help control erosion. Some areas are cropped to small grains and sorghums.

Good management of crop residue and the use of terraces, contour tillage, and cover crops are needed to reduce erosion and to improve soil structure and the intake of water. Periods suitable for tillage are shorter on this clayey soil than on more loamy soils. (Capability unit IIIe-5; Loamy Prairie range site; woodland suitability group, none)

Taloka Series

The Taloka series consists of deep, nearly level soils that have a medium-textured surface layer and a subsoil that is mostly fine textured. These soils developed in clayey alluvium and occur in prairie areas. The native vegetation is mainly little bluestem, big bluestem, indiangrass, and switchgrass.

In a typical profile, the surface layer, about 22 inches thick, is silt loam that is very dark grayish brown in the upper 12 inches and grayish brown in the lower part. This layer is very friable and friable and very strongly acid. The subsoil, to a depth of 49 inches, consists of dark grayish-brown and grayish-brown silty clay that is mottled with yellowish red, yellowish brown, and brownish yellow. This layer is very firm when moist and very strongly acid in the upper part, and is firm and slightly acid in the lower part. The next layer is neutral, light brownish-gray silty clay loam that is mottled with brownish yellow.

The Taloka soils are somewhat poorly drained because the subsoil is very slowly permeable. Surface wetness delays tillage for short periods after rains. These soils have high fertility but respond to additions of lime and fertilizer.

Taloka soils are used mostly for small grains, but some areas are in tame grasses.

Typical profile of Taloka silt loam, 0 to 1 percent slopes, about 1,590 feet west and 100 feet north of the southeast corner of section 29, T. 25 N., R. 22 E.:

Ap—0 to 12 inches, very dark grayish-brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) when dry; moderate, fine, granular structure; slightly hard, very friable; very strongly acid; gradual, smooth boundary; horizon 5 to 12 inches thick.

A2—12 to 22 inches, grayish-brown (10YR 5/2) silt loam, light gray (10YR 7/2) when dry; many, faint, yellowish-brown mottles; weak, fine, granular structure; hard, friable; very strongly acid; abrupt, smooth boundary; horizon 7 to 20 inches thick.

B21t—22 to 38 inches, dark grayish-brown (10YR 4/2) silty clay, grayish brown (10YR 5/2) when dry; common, medium, prominent mottles of yellowish red and yellowish brown; strong, medium, blocky structure; extremely hard when dry, very firm when moist; thin continuous clay films; few manganese concretions; few chert fragments; very strongly acid; gradual, smooth boundary; horizon 10 to 22 inches thick.

B22t—38 to 49 inches, grayish-brown (10YR 5/2) silty clay, light brownish gray (10YR 6/2) when dry; common, coarse, distinct mottles of brownish yellow; moderate, medium, blocky structure; very hard, firm; patchy thin clay films; fine manganese concretions; most peds coated with gray silt; slightly acid; gradual, smooth boundary; horizon 8 to 30 inches thick.

B3—49 to 60 inches, light brownish-gray (10YR 6/2) silty clay loam, light gray (10YR 7/2) when dry; common, medium, distinct, brownish-yellow mottles; weak, coarse, blocky structure; hard, firm; few concretions; few clay films in pores and cracks; gray silt coating on ped faces and in cracks; neutral.

Color of the Ap horizon is 10YR in hue, 3 or 4 in value, and 2 in chroma. The A2 horizon is 10YR in hue, 5 or 6 in value, and 2 in chroma. The boundary between the A2 and the B2t horizon is almost 3 inches thick in some places. Total thickness of the A horizon is more than 16 inches.

The B2t horizon is 10YR or 2.5Y in hue, 3 to 5 in value, and 1 to 2 in chroma. Mottles occupy less than 40 percent of the soil mass. This horizon ranges from heavy silty clay loam to clay and has a content of clay ranging from 38 to 55 percent. Reaction ranges from very strongly acid to slightly acid. The B3 horizon is 10YR in hue, 4 to 6 in value, and 1 or 2 in chroma. Its reaction ranges from medium acid to neutral.

The Taloka soils have a finer textured B horizon than the Newtonia and Choteau soils and a thicker A horizon than the Parsons soils. The A horizon of Taloka soils is lighter colored in the lower part than the Woodson soils. Taloka soils have a more abrupt texture change from the A horizon to the B horizon than have the Summit, Okemah, and Dennis soils.

Taloka silt loam, 0 to 1 percent slopes (TkA).—This deep soil has a claypan and occupies prairie uplands. Low mounds are common. The profile is the one described as typical for the series.

Included with this soil in mapping are areas of Parsons silt loam, totaling about 6 percent of the acreage mapped, and of Okemah silt loam, totaling about 2 percent. Also included are soils similar to this Taloka silt loam that have a more brownish and yellowish clay-enriched horizon. These included areas make up about 7 percent of the acreage mapped.

This soil is used mainly for wheat, corn, grain sorghum, soybeans, and tame pasture. Native grass grows in a few small areas.

The surface layer remains wet after heavy spring rains because the clayey subsoil limits permeability. A particular field may show a need for artificial drainage. Where this soil is cropped, producing large amounts of crop residue improves soil structure and the intake of water. Terraces on long slopes help control erosion. If managed properly, this soil is well suited to tame pastures and native grass. (Capability unit IIs–1; Loamy Prairie range site; woodland suitability group, none)

Talpa Series

The Talpa series consists of very shallow to shallow, very gently sloping to steep soils. These soils have a moderately fine textured layer over limestone at a depth of less than 20 inches. They occur on uplands, mostly in the prairie areas of Cherokee County. The native vegetation is mostly side-oats grama, little bluestem, and hairy grama.

In a typical profile the surface layer is very dark brown, neutral silty clay loam about 9 inches thick. It is firm when moist. It is directly underlain by consolidated, level-bedded limestone.

The Talpa soils are well drained and have moderately slow permeability. They hold a small amount of moisture that plants can use. Organic-matter content and natural fertility are high.

These soils are used mostly for native grasses and are well suited to them. A few areas are in tame pastures.

Typical profile of a Talpa soil that has a silty clay loam surface layer, about 570 feet west and 1,820 feet north of the southeast corner of section 7, T. 25 N., R. 22 E.:

A1—0 to 9 inches, very dark brown (10YR 2/2) light silty clay loam, dark grayish brown (10YR 4/2) when dry; moderate, medium, granular structure; hard, firm; neutral; abrupt, irregular boundary; horizon 2 to 15 inches thick.

R—9 inches +, consolidated, level-bedded limestone.

Color of the A1 horizon is 10YR in hue, 2 or 3 in value, and 2 in chroma. This horizon ranges from silty clay loam to clay loam and is 28 to 35 percent clay. The profile is noncalcareous or calcareous and ranges from slightly acid to moderately alkaline.

The Talpa soils have a dark surface layer that is thicker than that in the Hector and Linker soils. Talpa soils are less acid than the Collinsville soils and are more shallow to limestone than the Summit soils.

Talpa-Rock outcrop complex, 2 to 8 percent slopes (TrD).—This soil complex consists of a Talpa soil and outcrops of barren limestone rocks on uplands in prairie areas. The soil and Rock outcrop are so intermingled that they cannot be mapped separately at the scale of the soil map. The Talpa soil occupies 30 to 70 percent of this complex; Rock outcrop, about 10 to 20 percent; and deep, dark-colored, clayey soils, about 15 percent.

This complex is used mostly for grasses. The soils are not suitable for cultivation, because they are very shallow and are intermingled with Rock outcrop.

Grasses do not grow well on this complex, because rock outcrops are numerous and the Talpa soil is droughty. Areas must be managed carefully because the grass is replaced by sprouts and weeds on most of the acreage where it is overgrazed. The sprouts and weeds can be controlled by mowing or spraying. (Capability unit VIIs–2; Very Shallow range site; woodland suitability group, none)

Talpa-Rock outcrop complex, 15 to 50 percent slopes (TrF).—This soil complex consists of a Talpa soil and bare rocks, boulders, and ledges of limestone on prairie uplands of Cherokee County. The Talpa soil makes up 35 to 65 percent of this complex; rock outcrops, 20 to 50 percent; and dark, clayey soils that are more than 20 inches to limestone, about 10 percent. The Talpa soil has a black clay loam surface layer about 6 inches thick over limestone. The material in this layer is similar to that in the surface layer of the profile described for the Talpa series.

This complex is used for range and plants that provide food and cover for wildlife. It supports thin stands of grass and low brush.

Controlling brush is difficult because the complex is steep and rocky in many places. Maintaining a good plant cover to control erosion is desirable. (Capability unit VIIs–3; Very Shallow range site; woodland suitability group, none)

Verdigris Series

The Verdigris series consists of deep soils that have a medium-textured surface layer and a moderately fine textured subsoil. These nearly level soils formed in loamy alluvium on stream bottoms that are occasionally to frequently flooded. They occupy a small acreage in the two counties, but support a good stand of oak, elm, ash, walnut, and pecan trees.

In a typical profile the surface layer consists of very dark grayish-brown silt loam about 24 inches thick. It is medium acid. When moist, the upper part is friable and the lower part is firm. The subsoil is very dark grayish-brown silty clay loam that has a few, fine, faint olive mottles at a depth of about 42 inches. It is medium acid. When moist the subsoil is firm in the upper part, but it is friable below a depth of 42 inches.

The Verdigris soils are well drained and have moderately slow permeability. They contain large amounts of organic matter and plant nutrients. Tillage is easy, and crops grow well because available moisture capacity is high.

The frequently flooded soils are used mostly for trees and tame grasses. The occasionally flooded soils are commonly cropped to wheat, corn, soybeans, and grain sorghum.

Typical profile of Verdigris silt loam, about 1,700 feet west and 60 feet south of the northeast corner of section 2, T. 24 N., R. 24 E.:

A11—0 to 14 inches, very dark grayish-brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) when dry; moderate, fine, granular structure; hard, friable; medium acid; gradual, smooth boundary; horizon 10 to 18 inches thick.

A12—14 to 24 inches, very dark grayish-brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) when dry; moderate, fine and medium, granular structure; hard, firm; medium acid; gradual, smooth boundary; horizon 6 to 14 inches thick.

B21—24 to 42 inches, very dark grayish-brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) when dry; moderate, medium, subangular blocky structure; very hard, firm; medium acid; gradual, smooth boundary; horizon 8 to 20 inches thick.

B22—42 to 60 inches, very dark grayish-brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) when dry; few, fine, faint, olive mottles; moderate, coarse, subangular blocky structure; hard, friable; medium acid.

Color of the A1 horizon is 10YR in hue, 2 or 3 in value, and 1 or 2 in chroma. Texture ranges from silt loam to light silty clay loam. The A horizon is more than 24 inches thick in some places.

The B horizon is 10YR in hue, 2 or 3 in value, and 1 or 2 in chroma. It is 25 to 35 percent clay. Reaction ranges from medium acid to neutral.

The Verdigris soils are similar to the Staser soils but contain more silt and less sand. Verdigris soils have a thicker dark-colored A horizon than the Staser soils.

Verdigris silt loam (0 to 1 percent slopes) (Vd).—This deep soil occupies flood plains and low benches that are flooded occasionally. It is forested and has the profile described as typical for the series.

Included with this soil in mapping is a soil similar to this Verdigris soil that has a finer textured subsoil and a few gray mottles in its lower part. This included soil totals about 5 percent of the mapped acreage, and areas of Elsah soils total about 5 percent.

Verdigris silt loam is subject to occasional flooding that may destroy field crops. These floods seldom wash away undesirable soil material. This soil is used mostly for tame pastures, wheat, corn, sorghums, soybeans, and alfalfa. Hardwood trees grow in a few areas.

Practices that help maintain soil structure and fertility are returning crop residue to the soil and growing clover and green-manure crops. Tame pastures need mowing or spraying to prevent this soil from reverting to trees. Trees grown for timber need to be thinned, weeded, and properly harvested. (Capability unit IIw-1; Loamy Bottomland range site; woodland suitability group 1)

Verdigris soils, frequently flooded (0 to 1 percent slopes) (Vr).—This deep, loamy soil occurs in narrow strips on flood plains that are frequently flooded. These forest soils have a very dark gray surface layer of silt loam, loam, silty clay loam, and gravelly material. This layer is over a very dark grayish-brown silty clay loam subsoil that is similar to the subsoil in the profile described as typical for the series.

Included with this soil in mapping are areas of Verdigris silt loam that are not frequently flooded and that total about 10 percent of the mapped acreage. Also included are soils that are similar to Verdigris soils but that are lighter colored than very dark grayish brown at a depth of less than 24 inches. Other similar included soils have very gravelly layers within a depth of 30 inches. These two kinds of similar soils make up about 5 percent of the mapped acreages. Narrow stream channels and short breaks are also included in mapping.

These frequently flooded soils are used mainly for hardwood trees or tame pastures.

Hardwoods grow well when they are thinned, weeded, and selectively harvested. A good mulch is desirable on tame pasture so as to prevent excessive cutting and erosion. Brush control is needed. Flooding is a concern during periods when hay or trees are harvested. (Capability unit Vw-2; Loamy Bottomland range site; woodland suitability group 1)

Woodson Series

The Woodson series consists of deep, nearly level soils that have a medium-textured surface layer and a fine-textured subsoil. These soils developed in clayey alluvium and occur on prairie slopes. The native vegetation is mainly little bluestem, big bluestem, indiangrass, and switchgrass.

In a typical profile the surface layer consists of very dark gray silt loam about 10 inches thick. It is friable and medium acid. The subsoil extends to a depth of 60 inches and is very firm, very dark gray and dark gray silty clay that is mottled with yellowish brown, olive brown, and olive yellow. It is slightly acid in the upper part and moderately alkaline below a depth of 38 inches.

The Woodson soils are somewhat poorly drained because the subsoil is very slowly permeable. Surface wetness delays tillage for short periods after rain. These soils have high natural fertility but respond to additions of lime and fertilizer.

Woodson soils are used mostly for small grains, but some areas are in tame grasses.

Profile of Woodson silt loam, 0 to 1 percent slopes, about 2,300 feet south and 150 feet east of the northwest corner of section 20, T. 25 N., R. 24 E.:

A1—0 to 10 inches, very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) when dry; moderate, medium, granular structure; hard, friable; medium acid; clear, smooth boundary; horizon 8 to 14 inches thick.

B21tg—10 to 22 inches, very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) when dry; few, fine, faint, yellowish-brown mottles; moderate, medium, angular blocky structure; very hard, very firm; few clay films; slightly acid; gradual, smooth boundary; horizon 8 to 20 inches thick.

B22tg—22 to 30 inches, dark-gray (10YR 4/1) silty clay, gray (10YR 5/1) when dry; common, medium, distinct, olive-brown mottles; moderate, medium, angular blocky structure; very hard, very firm; clay films on ped surfaces; few manganese and calcium carbonate concretions; mildly alkaline; diffuse, smooth boundary; horizon 6 to 20 inches thick.

B31g—30 to 38 inches, dark-gray (10YR 4/1) silty clay, gray (10YR 5/1) when dry; few, fine, distinct, olive-yellow mottles; massive, very hard, very firm; clay films; few manganese and common calcium carbonate concretions; mildly alkaline; diffuse, smooth boundary; horizon 6 to 14 inches thick.

B32g—38 to 60 inches, dark-gray (5YR 4/1) silty clay; common, fine, distinct, olive-yellow mottles; massive; very hard, very firm; few manganese and common calcium carbonate concretions; moderately alkaline.

Color of the A1 horizon is 10YR in hue, 2 or 3 in value, and from 0.5 to 1.5 in chroma. The A1 horizon grades to the B2t horizon within a vertical distance of 3 inches.

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The B2t horizon is 10YR or 2.5Y in hue, 2 to 4 in value, and 0.5 to 1.5 in chroma. It is 40 to 55 percent clay. Reaction ranges from slightly acid to mildly alkaline. The B3 horizon ranges from 10YR to 5Y in hue, 3 to 5 in value, and 0.5 to 2 in chroma. Its reaction ranges from neutral to moderately alkaline.

The Woodson soils are more alkaline than the Taloka or Parsons soils and lack the A2 horizon characteristic of those soils. Woodson soils have a more abrupt change in texture between the A and B2t horizons than have the Dennis or Summit soils.

Woodson silt loam, 0 to 1 percent slopes (WoA).—This deep soil has a claypan and occurs on prairie uplands. The profile is the one described as typical for the series.

Included with this soil in mapping are areas of Okemah silt loam, Summit silty clay loam, and in some places, soils that have an A horizon thicker than 14 inches. The total acreage of these included areas is less than 8 percent of the acreage mapped.

Because the very slowly permeable subsoil is near the surface, this soil seasonally is both wet and dry. Drainage is poor. Erosion is a hazard only on long slopes of almost 1 percent.

This soil is used mainly for wheat, grain sorghum, and tame pasture grasses. A few small areas are in native grass.

By draining the surface of flats and slight depressions, loss of crops during planting and harvesting is reduced. Terraces are needed on long slopes of nearly 1 percent where the hazard of erosion is serious. If fertilizer is added, crop residue for return to the soil is increased, and this return increases the intake of water and lessens erosion. (Capability unit IIs-1; Claypan Prairie range site; woodland suitability group, none)

Use and Management of the Soils

The soils of Cherokee and Delaware Counties are used mostly for native grass range, for tame pasture, and for crops that support the raising of livestock. This section tells how the soils can be used for those main purposes, and also as woodland, for wildlife, as recreational sites, and in building roads, farm ponds, and other engineering structures.

Cultivated Crops and Tame Pasture [2]

Much of the survey area is used to produce crops and tame pasture. In the following paragraphs general practices are discussed that apply to the arable soils grouped in capability units. The capability units are described in the subsection "Management by Capability Units."

CULTIVATED CROPS

General practices that apply to most soils suitable for cultivation are use of minimum tillage, soil-improving crops, soil-depleting crops, and crop residue.

Minimum tillage is a desirable practice for reducing soil crusting and increasing water intake on all cultivated soils in the county. Excessive tillage of the Parsons, Osage, Summit, and similar soils causes compaction and crusting on the surface that inhibits emergence of young plants. Tillage operations should be at the proper time. If, for example, Osage soils are tilled when they are too wet, or if they are tilled excessively, the soil structure is broken down and the soils puddle and crust at the surface. As a result, less water and air are taken in for use of plants.

Soil-improving crops are especially suited to the very gently sloping Dennis, Newtonia, Okemah, and Bates soils on uplands. A cropping system including crops that produce large amounts of residue improves these soils (fig. 17, top).

Alfalfa and soybeans are soil-improving crops grown on Verdigris, Dennis, and other soils to maintain or improve the physical condition of the soils and to increase

Figure 17.—Top. **This crop of soybeans on Dennis silt loam, 1 to 3 percent slopes, improves the soil and helps maintain productivity.** ***Bottom:*** **Corn grown on Okemah silty clay loam, 1 to 3 percent slopes, returns sufficient crop residue that helps prevent erosion, except when the corn is cut for silage.**

[2] Prepared with the assistance of E. O. HILL, conservation agronomist, Soil Conservation Service.

crop growth. Where large amounts of wheat straw or crop residue from grain sorghum have been mixed into the soil, addition of nitrogen fertilizer is needed to prevent a shortage of nitrogen for the succeeding crop.

Soil-depleting crops on eroded Newtonia and Summit soils allow soil erosion, deterioration of soil structure, and reduction of the organic-matter content. Clean-tilled crops are soil depleting where forage is removed for silage or is cut low for bundle feeds or hay. On all soils in the county, a good cropping system provides only minimum use of soil-depleting crops. Corn is a common soil-depleting crop when cut for silage (fig. 17, bottom).

A plowpan forms just below plow depth when tillage implements are used too often at the same depth. Plowpans are common on Bates, Dennis, Parsons, and Summit soils. Varying the depth of tillage and planting deep-rooted legumes and grasses are ways to help prevent formation of plowpans and to eliminate those that have formed.

If, during winter and spring, crop residue is left on and near the surface of the very gently sloping Bates, Dennis, and Newtonia soils, it is effective in reducing erosion. Also, crop residue supplies organic matter, improves tilth of the surface layer, increases infiltration and the capacity for storing water, and reduces surface crusting. Crop residue also benefits the other arable soils in the county.

TAME PASTURE

A large acreage in the two counties is used for tame pasture. Grasses help to maintain the soil in good condition, and they also provide forage for livestock. Many soils that are not well suited to tilled crops are in tame pasture. Seedbed preparation is difficult on Elsah soils, Clarksville stony silt loams, and similar soils.

Bermudagrass is adaptable to most soils in the two counties and is more widely grown than other tame grasses. It is well suited to the Baxter and other loamy soils. This grass may be grown alone, but usually it is grown in a mixture with legumes, such as Korean lespedeza, Ladino clover, or yellow hop clover (fig. 18). On well-managed suitable soils, improved varieties of bermudagrass normally produce 20 to 25 percent more forage than common bermudagrass.

Fescue and bromegrass provide green forage late in fall and early in spring while bermudagrass is dormant. They are well suited to Verdigris silt loam and other soils that are fertile and that generally have good moisture content. On well-drained soils Ladino clover grows well in a mixture suitable for cool-season pasture, but more lime is required than for legumes such as yellow hop-clover.

Alfalfa, sericea lespedeza, or similar legumes are grown in a pure stand for hay and pasture. Small grains such as rye and oats are used for temporary cool-season pasture, and sudangrass is used for summer pasture and hay.

Proper use of pasture is necessary if plant growth is to be optimum. When grasses are grazed too short, the amount of forage is reduced. Proper use of pasture includes controlling undesirable vegetation, applying fertilizer effectively, providing adequate water, rotating the grazing, and stocking properly. It is often difficult to provide adequate water for Clarksville soils.

Figure 18.—**Bermudagrass and legumes on Baxter-Locust complex, 3 to 5 percent slopes, protect the soil from erosion and furnish good summer pasture for dairying.**

Tame pastures are more successful when properly fertilized. The increased value of land, and the need for more forage, make improvement in the fertilizer program necessary. Additions of fertilizer normally are needed for establishing stands of perennial pasture crops and for maintaining forage growth.

On timbered soils, such as Baxter cherty silt loam, 1 to 3 percent slopes, brush and weeds must be controlled or pasture plants will be crowded out in a few years. Control may be by use of chemicals, by mechanical means, or by a combination of these. Practices of weed control are often needed on Taloka silt loam and similar soils of the prairie.

Capability Groups of Soils

Capability classification is the grouping of soils to show, in a general way, their suitability for most kinds of farming. It is a practical classification based on the limitations of the soils, the risk of damage when they are used for the ordinary field crops or sown pastures, and the way they respond to treatment. The classification does not apply to most horticultural crops, or to rice and other crops that have special requirements for production. The soils are classified according to degree and kind of limitations, but without consideration of major and generally expensive landforming that would change the slope, depth, or other characteristics of the soils; and without consideration of possible major reclamation.

In the capability system, all soils are grouped at three levels, the capability class, the subclass, and the unit. These are discussed in the following paragraphs.

Capability Classes, the broadest groupings, are designated by Roman numerals I through VIII. The larger the numerals, the greater the limitations and the narrower the choices for practical use. The classes are defined as follows:

Class I. Soils have few limitations that restrict their use.

Class II. Soils have some limitations that reduce the choice of plants or require moderate conservation practices.

Class III. Soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV. Soils have very severe limitations that restrict the choice of plants, require very careful management, or both.

Class V. Soils subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife food and cover.

Class VI. Soils that have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife food and cover.

Class VII. Soils that have very severe limitations that make them unsuited to cultivation and restrict their use largely to grazing, woodland, or wildlife.

Class VIII. Soils and landforms that have limitations that preclude their use for commercial plant production without major reclamation and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes. (None mapped in Cherokee and Delaware Counties.)

Capability Subclasses are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c* used in those areas where climate is the chief limitation to the production of commonly cultivated crops.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only subclasses indicated by *w*, *s*, and *c*, because the soils in it are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife, or recreation.

Capability Units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-1 or IIIe-2. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation, and the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph. The Arabic numeral specifically identifies the capability unit within each subclass.

Management by capability units [3]

The soils in Cherokee and Delaware Counties have been placed in 28 capability units. The soils in each unit have about the same limitations, are subject to similar risks of damage, need about the same kind of management, and respond to management in about the same way. In the following pages each capability unit is described, and management of the soils in each unit is given. The mention of a soil series in the description of the unit does not mean that all the soils of the series mapped in the county are in the unit. To determine the soils in a capability unit, refer to the "Guide to Mapping Units" at the back of this survey.

CAPABILITY UNIT I-1

This unit consists of only Sallisaw silt loam, 0 to 1 percent slopes, a deep, dark-colored soil that has moderate permeability. It occurs on benches along the major streams in the two counties.

This soil has medium fertility and high available moisture capacity. It responds well to additions of lime and fertilizers.

The soil in this unit is suited to all crops commonly grown in this area. The main crops are winter wheat, sorghums, soybeans, and tame pasture plants. A few small areas are in timber or native grasses.

[3] Prepared with the assistance of C. Alvie Trissell, soil conservationist, and Orphas M. Triplett, work unit conservationist, Soil Conservation Service.

This soil has few limitations to farming. It can be used for continuous clean-tilled crops if enough crop residue is returned. Varying the depth of tillage is effective in removing tillage pans or preventing their formation.

CAPABILITY UNIT I–2

This unit consists of deep, dark-colored, nearly level soils on prairie uplands. These soils are in the Choteau, Newtonia, and Okemah series. They have a silt loam or silty clay loam surface layer and a subsoil that has moderate to slow permeability.

The soils in this unit have a good supply of organic matter that gives them good tilth. They have good available moisture capacity and are high in natural fertility. Crops respond well to good management that maintains soil structure and fertility (fig. 19).

The principal uses of these soils are for small grains, sorghums, soybeans, tame pasture grasses, and legumes. Some of the acreage is in native grasses.

These soils can be used for continuous clean-tilled crops when they are adequately fertilized and the crops return sufficient amounts of organic material. Crop residue returned to the soil helps maintain the soil structure and improves the water intake. In a few areas where the slopes are long, diversion terraces are used to prevent sheet erosion. Tilling at variable depths is effective in removing tillage pans or preventing their formation.

CAPABILITY UNIT IIe–1

This unit consists of deep to moderately deep, dark-colored loamy soils of the uplands that are gently sloping and slowly to moderately rapidly permeable. These soils are in the Bates, Choteau, Dennis, Eldorado, Newtonia, and Okemah series. They have high to medium natural fertility and fair to good available water capacity.

The soils in this unit are suited to all crops commonly grown in the area and to tame pasture and native grasses. Some of the more important crops are small grains, sorghums, and soybeans.

These soils are easy to till, and crops on them respond readily to applications of lime and fertilizer. Good management is needed to maintain soil structure and fertility and to control loss of soil through erosion. Cropping systems should provide for the return of adequate amounts of residue to the soil. Varying the depth of tillage is effective in preventing the formation of tillage pans.

Figure 19.—Excellent crop of soybeans on Newtonia silt loam, 0 to 1 percent slopes.

Where these soils are cultivated, some of the following practices also are helpful in preventing erosion: terracing, contour farming, and use of vegetated waterways or diversion terraces to divert water that may run in from adjacent slopes.

CAPABILITY UNIT IIe-2

This unit consists of deep, light-colored loamy soils that occur on uplands and benches along major streams. These nearly level to very gently sloping soils have moderate to slow permeability. They are in the Baxter, Captina, Jay, and Sallisaw series.

The soils of this unit normally are low in organic-matter content, but they have medium fertility and respond to additions of lime and fertilizer. Except for the Baxter and Sallisaw soils, which are cherty or gravelly, these soils have high available moisture capacity. The main management requirements are preventing erosion and maintaining soil structure and fertility.

These soils are used for small grains, sorghums, soybeans, tame pasture plants, and legumes. Some areas are in timber and native grasses.

Small grains or sorghums can be grown continuously if large amounts of crop residue are returned to the soil. Practices that are effective in reducing erosion are terracing, contour tillage, using vegetated waterways, and managing crop residue effectively. Varying the depth of tillage removes tillage pans or prevents their formation. In a few places diversion terraces are needed to divert the water that runs off adjacent slopes.

CAPABILITY UNIT IIw-1

This unit consists of deep, dark-colored loamy soils that occur on bottom lands and are subject to occasional flooding. These soils are in the Verdigris and Staser series. Permeability of the subsoil is moderately slow in the Verdigris soil and moderately rapid in the Staser soil.

The soils in this unit are high in content of organic matter and plant nutrients, and they respond readily to good management. Available water capacity is high. During heavy floods nearly all of the acreage is flooded, but only a few of the floods severely damage crops.

All crops suited to this area are adapted to these soils. Tame pasture plants, cultivated crops, and trees are the principal crops.

Bermudagrass, bromegrass, or fescue provides the base for most tame pastures. In these pastures good growth of high-quality plants is insured by use of improved varieties and by additions of fertilizer. The use of diversion terraces is beneficial in helping to control erosion in cultivated fields. Cover crops and large amounts of crop residue are needed on these soils during periods of flooding.

Flood control structures have been proposed to protect these soils in some areas. When these structures are installed, the protected soils are in class I.

CAPABILITY UNIT IIw-2

Stigler silt loam, 0 to 1 percent slopes, is the only soil in this unit. It is a deep, light-colored soil that occurs on uplands. Because this soil is very slowly permeable and somewhat poorly drained, the surface layer is wet for short periods.

The content of organic matter is low in this soil. Fertility is medium, and crops grow well or fairly well if management is good. Practices are needed for maintaining soil structure, increasing fertility, and improving infiltration and surface drainage.

The principal uses of this soil are for tame pasture, cultivated crops, trees, and native grasses. The main crops are small grains, sorghums, and soybeans, and the main pasture plants are bermudagrass, fescue, and adapted legumes.

Where cultivated crops are grown, large amounts of crop residue are needed. The formation of plowpans is prevented and soil structure preserved by keeping tillage at a minimum and varying its depth. Tillage that helps in draining low areas is beneficial and improves crop growth. Good growth of tame pasture plants can be obtained by adding fertilizer and using other good management. The use of improved varieties of grasses and legumes also insures good growth of plants in tame pastures.

CAPABILITY UNIT IIw-3

The only soil in this unit is Staser gravelly loam, a deep, dark-colored soil that occurs along streams and is flooded occasionally. This soil is nearly level to very gently sloping and has moderately rapid permeability.

The soil in this unit is fertile and has high organic-matter content. Crops grow well except in areas where the soil has a very gravelly subsoil. Occasional flooding is the main concern in cultivated areas, and tillage is difficult because of the gravelly surface layer.

This soil is used mainly for tame pasture and trees, but some small areas are cultivated. Bermudagrass and bromegrass or fescue are the main plants used in the tame pastures. The main cultivated crops are small grains and sorghums.

Where crops are grown on this soil, the return of large amounts of crop residue is needed for maintaining soil structure. Tame pasture can be improved by using improved varieties of grasses and adapted legumes and by adding fertilizer.

CAPABILITY UNIT IIs-1

This unit consists of deep, dark-colored silt loams that have a fine-textured subsoil. These nearly level soils are very slowly permeable and are wet for short periods after rains. They are in the Parsons, Taloka, and Woodson series.

These soils contain a large amount of organic matter and a medium to large amount of plant nutrients. Response to lime and fertilizer is good, but corn and some other crops do not grow well, because the clayey subsoil is droughty. The main concerns in managing these soils are penetration of water into the subsoil and seasonal wetness or droughtiness.

Small grains, sorghums, and tame pasture plants are well suited to these soils. A few small areas are in native grass. Bermudagrass and fescue are the main tame pasture plants.

Crop residue needs to be returned to these soils regularly to help maintain organic matter, improve soil structure, and increase the intake of water. In some areas terraces are needed to break up the concentration of water on long slopes. In flat or slightly depressional areas, drainage during wet periods is improved by directing crop rows towards outlets. Varying the depth of tillage helps to eliminate tillage pans.

CAPABILITY UNIT IIIe-1

This unit consists of deep, dark-colored, gently sloping silt loams on uplands. These soils are in the Eldorado and Newtonia series. The Eldorado soil has moderately rapid permeability and a cherty subsoil that limits available moisture capacity. The Newtonia soil is moderately permeable and has good available moisture capacity.

The soils in this unit are high in content of organic matter and natural fertility. Good cropping systems are needed for maintaining fertility and soil structure. Also needed are practices that lessen runoff and water erosion.

The principal crops grown on these soils are small grains, sorghums, soybeans, and tame pasture plants. Native grass grows in a sizable acreage.

Cropping systems can be varied but need to provide protective amounts of crop residue to maintain soil structure and control erosion. Varying the depth of tillage helps to remove tillage pans or to prevent their formation. In cultivated areas terraces and contour farming prevent the concentration of water and reduce erosion. In some places diversion terraces are needed to divert water from running in from adjacent, higher slopes. All terrace outlets should be kept in permanent vegetation. Native grasses grow well and provide forage or hay. In tame pasture the use of improved varieties of bermudagrass and adapted legumes is desirable.

CAPABILITY UNIT IIIe-2

Linker fine sandy loam, 2 to 5 percent slopes, is the only soil in this unit. It is a moderately deep to deep, light-colored soil that occurs on uplands in sandstone areas. This soil is well drained and has moderate permeability.

The soil of this unit has a medium content of organic matter. Its capacity to store available moisture is slightly limited in some areas where the sandstone occurs at a moderate depth. The main concerns in management are controlling soil blowing and water erosion and maintaining soil structure and fertility.

Tame pasture plants, sorghums, and small grains are the crops most commonly grown on this soil. These crops grow moderately well where management is good. Trees and grasses grow in many areas.

This soil is subject to soil blowing in cultivated areas. The soil needs additions of fertilizer and other management that produces large amounts of residue so as to help control soil blowing and improve the soil structure. Winter cover crops are beneficial in controlling soil blowing and in increasing the amount of crop residue.

Terraces and contour farming are needed if row crops are grown. Close-growing grasses and legumes are soil-improving crops that can be grown without terraces. Drainageways and terrace outlets safely remove excess water if they are seeded or sodded to permanent vegetation.

CAPABILITY UNIT IIIe-3

This unit consists only of Newtonia silt loam, 2 to 5 percent slopes, eroded, a deep, dark-colored soil. This soil occurs on uplands, is well drained, has moderate permeability, and is moderately eroded.

The soil in this unit is subject to severe erosion unless protected by adequate conservation practices. It has medium fertility and available moisture capacity but is poorly suited to crops because surface runoff and erosion are excessive. The main management needs on this soil are practices that encourage the growth of crops so that there is enough crop residue to control erosion and to maintain soil structure and fertility.

The main crops grown on this soil are tame grasses and legumes. A small acreage is used for small grains, sorghums, and native grass.

Where this soil is used for field crops, it needs to be fertilized so as to increase crop growth and the amounts of crop residue produced. Where this soil is cropped to sorghums, a winter cover crop is needed. Terraces and contour farming prevent further erosion. Other beneficial practices are using waterways and diversion terraces, varying the depth of tillage to increase water intake, and using minimum tillage to keep the maximum amount of crop residue in the surface layer. The best method of controlling erosion on this soil is by good management of soils in native grass and tame pasture.

CAPABILITY UNIT IIIe-4

This unit consists of Okemah silty clay loam, 3 to 5 percent slopes, a deep, dark-colored soil that has a clayey subsoil. This soil occurs on upland slopes, has slow permeability, and is moderately well drained.

This soil is high in organic-matter content and natural fertility, but crop growth is medium because the intake of water is slow and surface runoff is excessive. The management needs are practices that reduce runoff and prevent soil erosion. Adding lime and fertilizer increases crop growth and crop residue. Increased crop residue, in turn, helps to increase water intake and to maintain fertility and soil structure for better tilth.

The main use of this soil is for small grains, sorghums, tame pasture, and native grass.

Where this soil is cropped, intensive management practices are needed to prevent erosion. These practices include terracing, contour farming, adding fertilizer, and returning large amounts of residue to the soil. Other practices that are beneficial are using waterways, diversion terraces, and cover crops. Timely and minimum tillage normally help control erosion and preserve soil structure. The best conservation use of this Okemah soil is for tame pasture or native grass.

CAPABILITY UNIT IIIe-5

Summit silty clay loam, 2 to 5 percent slopes, eroded, is the only soil in this unit. It is a deep, dark-colored soil that has a clayey subsoil. It is moderately eroded and has slow permeability.

This soil is subject to continued erosion unless it is controlled by conservation practices. It has a good capacity to store moisture and is normally high in fertility. Erosion has limited the use of sorghums and other crops and has greatly reduced crop growth. The main management needs are practices that reduce runoff and prevent additional erosion. The use of fertilizer and lime helps maintain soil structure and increases crop residue for better tilth and intake of moisture.

This soil is used mainly for small grains and tame pastures. A few areas are reseeded to native grass.

Where this soil is used for small grains, it needs to be fertilized and managed for producing a large amount of crop residue that helps to control erosion. On fields in sorghums, erosion can be reduced by using cover crops,

terraces, and contour tillage. In some areas diversion terraces, waterways, and vegetated natural drains are needed to control runoff and prevent further erosion. Minimum and timely tillage to a depth that is varied each year helps to increase water intake, to keep residue in the surface layer, and to improve soil structure. The best method for controlling erosion is through good management of tame pastures or reseeded native grasses.

CAPABILITY UNIT IIIw-1

Osage clay is the only soil in this unit. This soil is deep, dark colored, nearly level, and clayey. It occurs on flood plains and benches along major streams. It is very slowly permeable and somewhat poorly drained.

This soil has a good supply of organic matter, is high in plant nutrients, and has good moisture storage capacity. The clayey texture limits the intake of water and restricts tillage to short periods. Seasonal wetness and occasional flooding are the main limitations that generally keep crop growth low.

The principal crops grown are small grains, sorghums, and tame pastures. Some areas are in timber. Where adequately drained, this soil is moderately well suited to wheat and barley. Small grains or crops sown for hay or pasture can be grown continuously.

The use of a suitable cropping system and the return of large amounts of crop residue to the soil increase organic matter, improve soil structure, and increase the intake of water. Tillage or grazing when the soil is wet compacts this soil excessively. Varying the depth of tillage is an effective way to remove tillage pans or prevent their formation.

CAPABILITY UNIT IIIs-1

This unit consists of deep, light-colored, very gently sloping, cherty soils on uplands. These soils are in the Baxter and Locust series. The Baxter soils of this unit have a subsoil that is moderately slowly permeable, and the Locust soils have a subsoil that is moderately permeable above the fragipan.

The soils of this unit have a low organic-matter content and medium natural fertility. They are poorly suited to crops, largely because the chert reduces capacity to hold moisture. Also, the cherty surface layer is difficult to till. Maintaining fertility and soil structure are the main management needs.

These cherty soils are best suited to orchard trees, strawberries, and tame pasture plants, including bermudagrass and locally adapted clovers. They are fairly well suited to small grains, corn, and vegetables. Because these soils are difficult to till, they are mostly used for tame pastures. A small acreage is in timber.

Where cultivated crops are grown, these soils need to be fertilized so that large amounts of crop residue can be returned to the soils. In local areas where these soils are eroded, diversion terraces and waterways are needed. Production of bermudagrass can be increased if one or more legumes, such as yellow hopclover or Korean lespedeza, are seeded with it and an adequate amount of fertilizer is applied.

CAPABILITY UNIT IVe-1

This unit consists of Sallisaw gravelly silt loam, 3 to 8 percent slopes, a deep, light-colored soil that occurs on benches along major streams. It is moderately permeable and well drained.

This soil has medium fertility, and crops on it respond readily to additions of fertilizer. The soil is only moderately suited to crops because the available moisture capacity is reduced by gravel. It is subject to erosion when conservation practices are not applied.

This soil is used mainly for tame pastures, small grains, sorghums, soybeans, strawberries, and orchard trees. The natural vegetation is timber and grass.

On this gravelly, well-drained soil, fertilization of close-growing crops produces a large enough amount of residue to control erosion without the use of terraces. Terraces, waterways, and contour tillage are needed where row crops are planted. Diversion terraces are needed in many areas to divert water from uplands. The gravelly surface soil makes minimum and timely tillage a desirable practice. With some crops, such as orchard trees, cover crops can be used to control erosion and maintain soil structure. The best method of preventing erosion is by growing tame pasture plants or timber.

CAPABILITY UNIT IVs-1

In this unit are deep, cherty and very cherty, very gently sloping to sloping soils of the uplands. These soils are in the Clarksville, Baxter, and Locust series. They are well drained to somewhat excessively drained and have moderately slow to rapid permeability.

The soils in this unit are low in organic-matter content and low to medium in natural fertility. The large amount of chert severely limits moisture storage capacity, causes droughtiness, and makes cultivation difficult. Crops normally are poorly suited, but these soils respond to good management that increases crop residue and helps to maintain soil fertility.

These soils are used mainly for tame pastures and native grasses, but large areas are in timber. If cultivated crops are grown, additions of fertilizer are needed and all crop residue should be returned to the soil. Plowpans can be removed by varying the depth of tillage. Contour farming helps to reduce erosion.

In most places the tame pastures consist of bermudagrass and lespedeza or fescue. These plants need to be fertilized if they are to grow well.

CAPABILITY UNIT Vw-1

Only Elsah soils are in this unit. These soils are in alluvium and are deep, dark colored, and very gravelly. They are excessively drained and rapidly permeable. They occur on flood plains that are frequently flooded. Streambanks, channels, and barren beds of gravel occur.

These soils are medium in fertility. They have a low available moisture capacity, but in many areas the water table is within the root zone of large trees.

These soils are not suitable for cultivation. They can be used for native grasses, tame pastures, hardwood trees, or plantings that provide wildlife food and cover. Tame pastures of bermudagrass, fescue, and legumes grow well where they can be established.

The main management concerns are frequent flooding, droughtiness in some places, and maintaining soil fertility.

CAPABILITY UNIT Vw-2

Only Verdigris soils, frequently flooded, are in this unit. These soils occur on flood plains and are deep, dark

colored, nearly level, and loamy. Narrow stream channels and short breaks occur.

These soils contain a large amount of organic matter and are fertile. They have moderately slow permeability and good available moisture capacity.

These soils are not suitable for cultivation unless flooding is controlled. They can be used for tame pastures, hardwood trees, and plantings that provide food and cover for wildlife. Some areas are in timber and native grasses. Tame pasture plants grow well where they are established. Bermudagrass is suitable because it withstands flooding very well.

The principal needs in managing these soils are practices that control flooding and maintain soil structure and fertility.

CAPABILITY UNIT VIe-1

The only soil in this unit is Hector fine sandy loam, 2 to 5 percent slopes. This very shallow to shallow, light-colored soil occurs on uplands in sandstone areas. It has moderately rapid permeability and is somewhat excessively drained because of slope and soil depth.

This soil is low in fertility and available moisture capacity. Timber and grass do not grow well under native conditions. Texture and limited depth are the main characteristics that make this soil droughty and not suited to crops.

Because this soil is susceptible to severe erosion, it normally is not suitable for cultivation. Intensive management and the use of legumes and grasses in the cropping system are needed. Tame pasture plants can be grown. Bermudagrass grown with lespedeza and yellow hopclover make good tame pasture. Good uses of this soil are native grasses or plants that provide food and cover for wildlife.

The severe risk of erosion is the chief concern in managing this soil. Soil fertility and structure must be considered when managing for bermudagrass. Where native grasses are grown, care needs to be taken not to permit overgrazing of the decreaser plants. Where brush is heavy, spraying for its control and proper grazing practices are helpful in improving the quantity and quality of forage.

CAPABILITY UNIT VIe-2

Only Collinsville fine sandy loam, 2 to 5 percent slopes, is in this unit. This very shallow to shallow, dark-colored, loamy soil occupies prairie uplands in sandstone areas.

This soil has moderately rapid permeability. Except in a few small areas, this soil is not cultivated. The shallow depth to sandstone limits the amount of moisture that can be furnished plants.

This Collinsville soil is not suitable for cultivation and is used mainly for native grasses and some tame pasture. Tame pasture plants do not grow well, because this soil is shallow and droughty. Native grasses grow well if management is good.

Controlling erosion and maintaining soil fertility and structure are the main needs in managing this soil. The best method of preserving the soil is by keeping it in tame pastures and native grasses.

CAPABILITY UNIT VIs-1

Clarksville stony silt loam, 5 to 20 percent slopes, is the only soil in this unit. It is deep, light colored, has a stony surface layer and subsoil, and occurs on uplands. This soil is somewhat excessively drained and has rapid permeability.

The fertility and organic-matter content of this soil are low. Stones in the surface layer and subsoil limit the moisture available to plants.

This soil generally is not suited to cultivated crops except special crops such as strawberries. Special crops are sometimes grown for a few years after an area is cleared and before native grasses or tame pastures are established. Tame pasture plants can be grown on this soil, except in small areas where this soil is too steep for mowing or spraying. This Clarksville soil is better suited to native grasses, pine, or hardwoods than it is to tame pasture.

Excessive slopes and practices that maintain soil fertility and structure, decrease stoniness, and control erosion are the main concerns in managing this soil. Spraying for control of trees and brush helps to increase the growth of native grasses.

CAPABILITY UNIT VIs-2

Only Eldorado soils, 3 to 12 percent slopes, are in this unit. These are deep, dark-colored soils that occur on uplands and have a cherty, stony, loamy surface layer and a very cherty subsoil. They are moderately rapid in permeability.

These soils are fertile and contain large amounts of organic matter in the surface layer. Although available moisture capacity is low, native grasses grow well in normal seasons. These soils are generally not suitable for cultivation, because they are stony and droughty and water erosion is a severe hazard.

The main use of these soils is for native grasses. When properly grazed and managed, the native grasses grow well and produce large amounts of hay or forage. The grass furnishes sufficient cover for upland game.

CAPABILITY UNIT VIIs-1

This unit consists of Clarksville stony silt loam, 20 to 50 percent slopes, a deep, light-colored, stony soil on uplands. This somewhat excessively drained soil has rapid permeability.

The soil in this unit is low in natural fertility and content of organic matter. Because the soil is stony, it stores only a small amount of moisture for plant use. It is not cultivated, because it is steep, stony, and susceptible to very severe erosion. Use of machinery is limited.

This soil is well suited as woodland, to grass, or to plants that provide wildlife food and cover. Trees generally do not grow well.

Tame pasture cannot be successfully established and managed, because brush is very difficult to control on this steep, stony soil. The soil should not be cleared but should be grazed as woodland.

CAPABILITY UNIT VIIs-2

This unit consists of Talpa-Rock outcrop complex, 2 to 8 percent slopes. The dark-colored, loamy Talpa soil and outcrops of rock in this complex occur on uplands in limestone areas. The Talpa soil is very shallow or shallow and has moderately slow permeability. It occupies about 30 to 70 percent of this complex, and rock outcrops occupy 10 to 20 percent.

The Talpa soil is fertile and has high content of organic matter, but low available moisture capacity. It is not culti-

vated, because it has numerous rock outcrops, and is very severely susceptible to erosion.

This complex is suited to native grasses, and most areas are in these grasses. Practices that control grazing and the scattered brush help to maintain a good stand of grass.

CAPABILITY UNIT VIIs-3

This unit consists of Talpa-Rock outcrop complex, 15 to 50 percent slopes. This complex of the dark-colored, loamy Talpa soil and outcrops of rock occupies uplands in limestone areas. The very shallow to shallow Talpa soil has moderately slow permeability and occupies about 35 to 65 percent of the complex. Rock outcrop occupies 20 to 50 percent and consists of bare rocks, boulders, and rock ledges.

The Talpa soil has a high content of organic matter and is fertile, but its available moisture capacity is low. Rock outcrops, shallow depth, steep slopes, and susceptibility to water erosion make this soil complex unsuitable for cultivation.

This soil is used for native grasses and for plants that provide wildlife food and cover.

Because of the high percentage of rock outcrops and the steep slopes, domestic livestock do not find good grazing. If the complex is used for grazing, a good cover of plant residue must be left on the ground to prevent erosion. In some areas brush control helps improve growth of the native grass.

CAPABILITY UNIT VIIs-4

This unit consists of only Rough stony land. This land is made up of shallow and very shallow, stony, loamy soils and rock outcrops. This unit is very steep and has some vertical cliffs and ledges.

This land is not suited to the use of machinery, because it is stony, steep, and subject to very severe erosion. It is suited to native grasses and to plants that provide food and cover for wildlife. The use of grass for grazing is limited because many areas are not accessible to livestock. In some areas brush needs to be controlled so as to improve the growth of grass.

CAPABILITY UNIT VIIs-5

Only Hector-Linker association, hilly, is in this unit. This association consists of light-colored, strongly sloping to steep, stony and loamy soils on timbered uplands in sandstone areas. The very shallow to shallow Hector soils have moderately rapid permeability, and the deeper Linker soils have moderate permeability.

The growth of trees and grass is limited because the soils in this unit are low in organic-matter content, and the Hector soils have low fertility and low available moisture capacity. The stones and steep slopes limit the use of machinery. These soils are susceptible to severe water erosion if they are not properly managed.

These soils are suited as range or to plants that provide wildlife food and cover. Tame pasture plants do not grow well, because the soils are steep and stony. Trees grow fairly well on the deeper Linker soils.

Whatever use is made of these soils, care must be taken to keep them covered at all times. An adequate amount of plant residue must be left on the ground to prevent erosion.

Yield Predictions[4]

In table 2 are predictions of long-term average acre yields for the principal crops grown on the cultivated soils of these counties under two levels of management. The yields in columns A are to be expected under management commonly used in the county; those in columns B are yields to be expected under improved management.

These predictions are based on information obtained from farmers and ranchers, members of the soil survey party, and personnel of Oklahoma State University who have access to research records applicable to the crops and soils of the survey area. Crop failures were considered in predicting average yields.

Common management (columns A) includes (1) using proper seeding rates, appropriate planting dates, and efficient harvesting methods; (2) controlling weeds, insects, and plant diseases; (3) using mainly terraces and contour farming where necessary; (4) using mainly the moldboard plow and the one-way disc plow and (5) using small amounts of fertilizer.

Improved management (columns B) includes (1) using proper seeding rates, appropriate planting dates, and efficient harvesting methods; (2) controlling weeds, insects, and plant diseases; (3) using terraces and contour farming where necessary; (4) selecting suitable improved crop varieties; (5) managing crop residue and tillage so as to control erosion and conserve moisture; and (6) fertilizing so as to obtain optimum crop growth.

Specific conservation practices are discussed in the subsection "Management by Capability Units." Information on improved crop varieties and on fertilizer application can be obtained from the county agency or from technicians of the Soil Conservation Service.

Mapping units not generally suitable or used for crops are not included in table 2. They are Clarksville stony silt loam, 20 to 50 percent slopes; Eldorado soils, 3 to 12 percent slopes; Hector-Linker association, hilly; Talpa-Rock outcrop complex, 2 to 8 percent slopes; Talpa-Rock outcrop complex, 15 to 50 percent slopes; and Rough stony land.

Irrigation

Irrigation is expensive, but it can be made to pay by installing an efficient irrigation system to supplement local rainfall. The feasibility of irrigation is determined mainly by the nature of the soil and the quality and quantity of water available (*2*).

To be suitable for irrigation, a soil must be (1) productive, (2) capable of storing enough water to meet the needs of plants, (3) not too sloping, (4) permeable enough to prevent accumulation of salts, and (5) deep enough to allow necessary leveling and to provide an adequate root zone. Soils in capability classes I and II are best suited to irrigation. Soils that are gravelly or cherty are best suited to strawberries or other special crops. The irrigation is more successful on nearly level or gently sloping gravelly or cherty soils than on more strongly sloping soils.

In the two counties the main sources of water for irrigation are from reservoirs, spring-fed streams, underground

[4] Prepared with the assistance of JAMES R. CULVER, soil scientist, Soil Conservation Service.

TABLE 2.—*Predicted average acre yields of principal crops*

[Yields in columns A are those expected under common management; those in columns B are expected under improved management. Absence of yield indicates that crop is not commonly grown on the soil at the level of management specified]

Soil	Wheat		Corn		Soybeans		Grain sorghum		Common bermudagrass		Straw-berries	Apples	Beans
	A	B	A	B	A	B	A	B	A	B	B	B	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Animal-unit-months* [1]	*Animal-unit-months* [1]	*Quarts*	*Bu.*	*Tons*
Bates loam, 1 to 3 percent slopes	18	27	28	40	14	23	28	42	4. 0	6. 0	----	----	----
Baxter silt loam, 1 to 3 percent slopes	13	21	28	40	13	21	25	36	3. 5	5. 5	----	180	2. 2
Baxter cherty silt loam, 1 to 3 percent slopes	10	18	23	36	11	18	18	34	2. 8	5. 0	2, 760	180	2. 0
Baxter-Locust complex, 3 to 5 percent slopes	10	17	23	36	11	18	18	30	2. 8	5. 0	2, 760	180	2. 0
Captina silt loam, 1 to 3 percent slopes	13	21	28	40	13	21	25	36	3. 5	5. 5	----	180	2. 2
Choteau silt loam, 0 to 1 percent slopes	21	30	33	50	15	25	33	50	4. 0	6. 0	----	----	----
Choteau silt loam, 1 to 3 percent slopes	20	29	31	48	12	22	31	48	4. 0	6. 0	----	----	----
Clarksville very cherty silt loam, 1 to 8 percent slopes	8	15	20	32	8	14	16	42	2. 8	4. 5	2, 760	----	----
Clarksville stony silt loam, 5 to 20 percent slopes	----	----	----	----	----	----	----	----	1. 5	3. 5	2, 760	----	----
Collinsville fine sandy loam, 2 to 5 percent slopes	----	----	----	----	----	----	----	----	2. 0	4. 0	----	----	----
Dennis silt loam, 1 to 3 percent slopes	21	30	29	42	14	21	34	48	4. 0	6. 0	----	----	----
Eldorado silt loam, 1 to 3 percent slopes	14	23	28	40	11	19	27	44	4. 0	6. 0	----	----	----
Eldorado silt loam, 3 to 5 percent slopes	13	22	26	36	10	18	25	41	3. 5	5. 5	----	----	----
Elsah soils	----	----	----	----	----	----	----	----	2. 0	4. 0	----	----	----
Hector fine sandy loam, 2 to 5 percent slopes	----	----	----	----	----	----	----	----	2. 0	3. 5	2, 640	150	1. 5
Jay silt loam, 0 to 2 percent slopes	21	30	28	40	12	20	30	48	4. 0	6. 0	----	----	----
Linker fine sandy loam, 2 to 5 percent slopes	15	23	21	34	11	19	20	34	3. 5	5. 5	2, 640	180	1. 8
Locust cherty silt loam, 1 to 3 percent slopes	12	18	23	36	11	18	18	32	3. 0	4. 5	2, 760	180	2. 0
Newtonia silt loam, 0 to 1 percent slopes	22	32	34	50	17	26	36	55	4. 5	6. 5	----	----	----
Newtonia silt loam, 1 to 3 percent slopes	19	29	31	44	13	22	31	47	4. 0	6. 0	----	----	----
Newtonia silt loam, 3 to 5 percent slopes	18	29	23	35	11	19	27	42	3. 5	5. 5	----	----	----
Newtonia silt loam, 2 to 5 percent slopes, eroded	14	21	----	----	----	----	21	33	3. 0	4. 5	----	----	----
Okemah silt loam, 0 to 1 percent slopes	22	32	33	50	16	25	38	52	4. 0	6. 0	----	----	----
Okemah silty clay loam, 0 to 1 percent slopes	22	31	33	50	15	24	37	48	4. 0	6. 0	----	----	----
Okemah silty clay loam, 1 to 3 percent slopes	20	28	29	42	12	21	33	45	4. 0	6. 0	----	----	----
Okemah silty clay loam, 3 to 5 percent slopes	18	25	22	32	10	17	28	40	3. 5	5. 5	----	----	----
Osage clay	14	20	21	31	----	----	31	40	2. 9	4. 5	----	----	----
Parsons silt loam, 0 to 1 percent slopes	18	30	23	34	12	20	25	40	2. 9	4. 5	----	----	----
Sallisaw silt loam, 0 to 1 percent slopes	21	30	33	56	15	25	34	50	4. 8	6. 5	----	180	2. 2
Sallisaw silt loam, 1 to 3 percent slopes	18	26	32	48	13	22	32	46	4. 0	6. 0	----	180	2. 2
Sallisaw gravelly silt loam, 1 to 3 percent slopes	14	21	28	46	19	26	30	44	4. 0	6. 0	2, 760	180	2. 1
Sallisaw gravelly silt loam, 3 to 8 percent slopes	12	18	27	39	16	22	26	37	3. 8	5. 0	2, 640	150	1. 6
Staser silt loam	23	29	46	55	21	30	34	51	5. 0	8. 8	----	----	----
Staser gravelly loam	14	22	36	43	17	25	31	46	4. 5	6. 5	----	----	----
Stigler silt loam, 0 to 1 percent slopes	17	27	27	40	16	24	27	41	3. 5	5. 0	----	----	----
Summit silty clay loam, 2 to 5 percent slopes, eroded	14	20	----	----	----	----	23	36	3. 0	4. 5	----	----	----
Taloka silt loam, 0 to 1 percent slopes	21	31	29	45	15	23	34	51	3. 5	5. 0	----	----	----
Verdigris silt loam	26	35	47	68	24	33	47	68	5. 0	8. 0	----	----	----
Verdigris soils, frequently flooded	----	----	----	----	----	----	----	----	4. 5	7. 5	----	----	----
Woodson silt loam, 0 to 1 percent slopes	16	24	----	----	----	----	26	41	2. 9	4. 5	----	----	----

[1] Animal-unit-months is a term used to express the carrying capacity of pasture. It is the number of animal units, or 1,000 pounds of live weight, that can be grazed on an acre of pasture for a period of 30 days.

water in alluvial material along major streams, and underground water in upland areas where the quantity is sufficient. The best source probably is reservoirs.

Wells are needed to tap a source of underground water. The depth to the underground water level ranges from only a few feet near the streams in the county to about 100 to 400 feet in upland areas. The quality of the underground water generally is good. The quantity that can be obtained from a single well ranges from 50 to 800 gallons per minute. Each well should be subjected to a 24- to 48-hour pumping test, which will determine the drawdown, the pumping lift, and the capacity of the well. Information on drawdown, lift, and well capacity is essential for the selection of an efficient pumping plant and for the design of a suitable irrigation system.

Before investing in an irrigation system, a water right must be obtained because it is necessary before water can be taken for irrigation. An application for a water right must be filed with the Oklahoma Planning and Resource Board. To obtain water from some of the reservoirs in the two counties, an application must be filed with the Grand River Dam Authority.

A surface system is best for some soils in this county, and a sprinkler system for others. The selection of a system depends on the lay of the land, the cost of leveling, the kinds of crops to be grown, and other factors. The main types of

surface irrigation used in the county are border and furrow. A border system is best suited to loamy soils that have slopes of less than 3 percent. For efficient use of water, a border system requires land leveling, a fairly large stream of water, corrugations on clayey soils, short runs on fine sandy loams, and close-growing crops on slopes of more than 1 percent.

A furrow system is suitable for all soils that have slopes of less than 5 percent. Small amounts of water can be distributed evenly by this system, and row crops can be irrigated easily. The limitations of a furrow system are the need for short runs on fine sandy loams, the complicated layouts on rolling land, the maintenance requirements, and the difficulty of harvesting crops.

A sprinkler system is best for nearly level to sloping loamy soils. The advantages of such a system are that land leveling, ditches, or surface drainage systems are not required, and that the equipment can be moved from field to field. The disadvantages are the high cost of installation and maintenance, the difficulty of moving a portable system in cultivated fields, the risk of increased fungus growth, and the failure of some crops to bear fruit if the blossoms are sprinkled. Sprinkler irrigation is not suitable for clayey soils, which take in water slowly.

All crops commonly grown in the county can be grown under irrigation, but irrigated soils need intensive management for control of erosion and maintenance of productivity. If markets are available, irrigation of field crops, nurseries, orchards, truck crops, and grass can be successful (fig. 20).

Management of Range [5]

In Cherokee and Delaware Counties about 87 percent of the total farm and ranch income is from the sale of livestock, milk, and other livestock products. Much of the livestock is supported by the native grasslands, commonly called rangeland.

Most of the rangeland in the two counties is savannah, or grassland that has scattered trees. At the time of settlement, native grasses grew well in the savannah, but now they do not, because in much of the area grazing and burning have been excessive. Livestock production probably could be increased at least fivefold by brush control and other needed practices of management.

[5] By HARLAND E. DIETZ, range conservationist, Soil Conservation Service.

Figure 20.—Nursery stock being irrigated on Sallisaw silt loam.

Prairie rangeland is essentially free of trees. It occurs throughout the survey area, but the total acreage is small. It is primarily in meadow used for native grass hay.

Range sites and condition classes

A range site is distinguished by its ability to produce native plants. It consists of soils that are similar in depth, texture, permeability, and topography. The sites differ significantly in the kind of natural vegetation they now support; in the kinds of original, or climax, vegetation they once supported; and in the kind of management they need. Knowing the potential of the various range sites is a part of good range management. Generally, a productive range site is made up of deep soils in an area favorable for growing the taller, more productive grasses. Such sites can carry more livestock than the shallow and droughty sites.

On range sites, the original, or climax, vegetation is considered the most productive combination of plants that will maintain itself under natural conditions. Continuous excessive grazing alters this original plant cover and lowers productivity. The livestock seek out the more palatable and nutritious grasses, and under heavy grazing these choice plants, or *decreasers*, are weakened and gradually eliminated. These plants are replaced by less palatable plants, or *increasers*. If heavy grazing continues, even these increasers are weakened and the site is eventually occupied by less desirable grasses and weeds, which are called *invaders*.

The downward trend in range vegetation is generally systematic under heavy grazing and can be expressed as range condition. Four classes of range condition are recognized—excellent, good, fair, and poor. On range in excellent condition, 76 to 100 percent of the plant cover consists of original vegetation. Range in good condition has a plant cover such that 51 to 75 percent of the vegetation is the kind that originally grew on the site. On range in fair condition, 26 to 50 percent of the vegetation is that originally on the site; and on range in poor condition, 25 percent or less of the original vegetation remains.

Changes in kinds of vegetation usually take place so gradually that they are often overlooked by the operator who is not acquainted with the vegetation and soils. Sometimes during periods of favorable rainfall, plant growth is stimulated, and the operator concludes that the range is improving when actually the long-term trend is toward poorer grasses and to weeds and lower production. On the other hand, a dry season may result in overgrazing of a healthy range and cause it to appear degraded when actually the setback is only seasonal and temporary.

Range condition may be satisfactorily determined on a site any day of the year. Current range condition class guides that catalog the plants commonly found on each range site are kept in the work unit office of the Soil Conservation Service.

Descriptions of range sites

The soils of Cherokee and Delaware Counties have been grouped into range sites according to their ability to produce similar kinds and amounts of climax vegetation. In the following paragraphs the soils in each site are described and the names of the common plants that grow under different degrees of grazing are briefly discussed.

The yields of air-dry herbage given for each range site are estimates based on limited amount of clippings and research. The total growth of herbage was obtained by clipping the vegetation, except for the woody plants, at ground level from sites on which grazing was deferred. The forage was then air-dried, weighed, and calculated in pounds per acre. Since rainfall fluctuates widely from year to year, estimates are given for both favorable and unfavorable years.

The amount of forage consumed by grazing livestock is considerably less than the total yield listed for each range site. Natural losses of vegetation caused by rodents, insects, weathering, and other causes may account for 15 to 25 percent of the total growth. Consequently, on ranges where grazing is managed to leave 50 percent of the year's production, the livestock may have actually consumed only 25 to 35 percent of the total growth.

On any given range site, the growth of forage fluctuates from year to year according to variations in climate. The extent of these fluctuations depends on the nature of the site, the condition and vigor of the vegetation, and the moisture content of the soils. Management should be flexible to allow for such variations. Stocking can be heavier during periods of favorable rainfall, but reduction in number of livestock may be necessary during extended periods of drought.

In the survey area, short droughts are common in summer. During these periods the deep-rooted climax grasses on well-managed sites absorb moisture from the subsoil and continue to grow. Shallow-rooted plants on sites in poor condition, however, do not grow and become more or less dormant as moisture is exhausted. Then it may be necessary to begin costly supplemental feeding prematurely.

The soils in each range site are listed in the "Guide to Mapping Units" at the back of this soil survey. In the descriptions of the range sites, the mention of the soil series represented in the site does not necessarily mean that all the soils of the series mapped in the two counties are in the site.

BREAKS RANGE SITE

Only Rough stony land is in this range site. This land occurs on steep bluffs or escarpments. The soil material is very shallow and shallow and normally is underlain by limestone bedrock that crops out on the slopes. Moderately deep pockets of soil occur between the rock outcrops in some places.

The climax vegetation is predominantly tall and mid grasses. Growing in the deeper pockets of soil are big bluestem, indiangrass, switchgrass, and little bluestem. The more shallow soils support side-oats grama and little bluestem, and hairy grama grows in a few of the very shallow parts. Rough stony land supports numerous climax legumes, such as catclaw sensitivebrier, Illinois bundleflower, leadplant, Virginia tephrosia, and prairie clovers. Climax forbs commonly present are pale echinacea, pitchers sage, and compassplant.

Grasses are normally intermixed with a variety of woody plants. Large chinkapin oak trees are scattered on the site. Hawthorn, skunkbush, roughleaf dogwood, plum, and hackberry are common. These woody plants increase in abundance if overgrazing is continuous.

Grasses that increase on these soils where grazing is heavy include tall dropseed, side-oats grama, purpletop, hairy grama, and silver bluestem. Among the increaser forbs are heath aster, Louisiana sagewort, sticky goldenrod, redroot wild-buckwheat, and green antelopehorn.

Undesirable plants that invade where this site is continuously overgrazed are broomsedge bluestem, oldfield three-awn, fall witchgrass, tumblegrass, western ragweed, common broomweed, bitter sneezeweed, and poorjo.

The potential yield of air-dry herbage ranges from 3,000 pounds per acre in years of favorable moisture to 1,600 pounds per acre in years of unfavorable moisture.

CLAYPAN PRAIRIE RANGE SITE

The soils of this site are nearly level and have a heavy claypan at a depth ranging from 8 to 16 inches. These soils are in the Parsons and Woodson series. The claypan restricts the growth of plant roots and slows the absorption of water. The surface layer is wet during periods of high rainfall, but it is droughty when rainfall is less than normal.

The principal decreaser plants on this site are big bluestem, little bluestem, switchgrass, indiangrass, leadplant, tall gayfeather, and ashy sunflower (fig. 21).

Plants that increase following prolonged overgrazing include meadow dropseed, knotroot bristlegrass, purpletop, dotted gayfeather, sticky goldenrod, and heath aster. When the better range plants are depleted, the site is invaded by broomsedge bluestem, splitbeard bluestem, ragweed, ironweed, and bitter sneezeweed.

The potential yield of air-dry herbage ranges from 5,500 pounds per acre in years of favorable moisture to 3,500 pounds per acre in years of unfavorable moisture.

HEAVY BOTTOMLAND RANGE SITE

Only Osage clay is in this range site. This soil occurs on bottom lands and is deep and clayey. It is somewhat poorly drained and subject to flooding. When this clayey

***Figure 21.*—Claypan Prairie range site in excellent condition. A fireguard is used to protect the forage that is saved for winter grazing. The strip adjacent to the road is burned early in fall to protect the grasses from fire. The soil is Parsons silt loam, 0 to 1 percent slopes.**

soil is dry, it is hard and large vertical cracks are common. Forage plants grow well during years of abundant rainfall, but they grow poorly during periods of drought.

The climax vegetation is influenced by flooding and soil wetness. The vegetation ranges from a nearly pure stand of prairie cordgrass on the more poorly drained areas to a mixture of tall grasses where the soils are better drained. These tall grasses include eastern gamagrass, switchgrass, big bluestem, indiangrass, Florida paspalum, broadleaf uniola, and wildrye. Important forbs that grow on the site are Maximillian sunflower and wholeleaf rosinweed.

Plants that increase when the better forage grasses are weakened are little bluestem, tall dropseed, meadow dropseed, knotroot bristlegrass, goldenrod, sedges, and rushes. Woody plants that increase when these soils are not well managed include hackberry, elm, pecan, walnut, and oak.

Weedy plants that invade the site after prolonged overgrazing are seacoast sumpweed, ironweed, white crownbeard, giant ragweed, coralberry, and broomsedge bluestem.

The potential yield of air-dry herbage ranges from 8,000 pounds per acre in years of favorable moisture to 5,000 pounds per acre in years of unfavorable moisture.

LOAMY BOTTOMLAND RANGE SITE

This site consists of nearly level, occasionally to frequently flooded Staser and Verdigris soils on bottom lands along major streams. These deep, fertile, loamy soils have an excellent available moisture capacity that promotes plant growth. The occasionally flooded soils are normally cultivated, but the frequently flooded soils have a cover of trees and grasses.

When in excellent condition, the site is dominated by tall, productive, warm-season grasses, mainly big bluestem, indiangrass, eastern gamagrass, prairie cordgrass, and switchgrass.

Plants that increase when the site is overgrazed are little bluestem, tall dropseed, meadow dropseed, purpletop, knotroot bristlegrass, and longspike tridens.

A few large native trees grow on this site, especially along streambanks and in frequently flooded areas. The most common trees are elm, sycamore, walnut, pecan, oak, and hackberry. If overgrazing is continuous, trees increase. Growing under the canopy of these trees are Canada wildrye, Virginia wildrye, and sedges, which are cool-season plants tolerant of shade.

The most common invaders are broomsedge, ironweed, giant ragweed, seacoast sumpweed, white snakeroot, white crownsbeard, and coralberry.

The potential yield of air-dry herbage ranges from 11,000 pounds per acre in years of favorable moisture to 8,000 pounds per acre in years of unfavorable moisture.

LOAMY PRAIRIE RANGE SITE

The soils of this site are on uplands and are moderately deep or deep, permeable, and nearly level to strongly sloping. These soils are in the Bates, Choteau, Dennis, Eldorado, Jay, Newtonia, Okemah, Summit, and Taloka series. They have a loamy surface layer and a subsoil with slow to moderately rapid permeability. Moisture penetrates the soils well and promotes growth of deep roots. A large part of this productive site is used for native meadow that is mowed for hay (fig. 22).

Under good management tall grasses dominate this site. Big bluestem, little bluestem, indiangrass, and switchgrass make up about 90 percent of the vegetation. Prairie cordgrass and eastern gamagrass grow along many of the prairie drainageways. Decreaser legumes and forbs that generally grow in the better managed pastures and meadows include leadplant, Virginia tephrosia, catclaw sensitivebrier, Illinois bundleflower, compassplant, and perennial sunflower. Decreaser grasses, forbs, and legumes are gradually replaced by increasers if this site is continually overgrazed. Among these increasers are meadow dropseed, knotroot bristlegrass, purpletop, jointtail, heath aster, prairie sagewort, and goldenrod.

Plants that commonly invade the site are broomsedge bluestem, splintbeard bluestem, windmillgrass, ragweed, and ironweed.

The potential yield of air-dry herbage ranges from 7,500 pounds per acre in years of favorable moisture to 4,500 pounds per acre in years of unfavorable moisture.

SANDY SAVANNAH RANGE SITE

This site consists of deep to moderately deep, well-drained Linker soils on uplands. These soils typically have a fine sandy loam surface layer that permits good moisture intake and a clay loam subsoil that has good available moisture capacity. Under good management, range plants grow well on this site.

The original vegetation is a mixture of scattered trees and tall, productive grasses. The trees are mainly post oak, blackjack oak, red oak, and hickory. The grasses are little bluestem, big bluestem, indiangrass, switchgrass, and Canada wildrye.

Where this site is overgrazed, brush increases, as do purpletop, tall dropseed, Scribner panicum, goldenrod, and similar plants. Invaders are broomsedge bluestem, splitbeard bluestem, ironweed, rough buttonweed, coralberry, persimmon, and sassafras. Control of undesirable brush is usually necessary to speed recovery of the better grasses.

The potential yield of air-dry herbage ranges from 5,500 pounds per acre in years of favorable moisture to 3,500 pounds per acre in years of unfavorable moisture.

SHALLOW PRAIRIE RANGE SITE

Only Collinsville fine sandy loam, 2 to 5 percent slopes, is in this site. This soil developed from weathered sandstone and is very shallow or shallow.

Shallowness normally limits growth of forage plants on this soil. In a few areas, however, the sandstone material is soft and broken and permits moderately deep moisture and root penetration. In these places forage plants grow nearly as well as on Loamy Prairie range site.

Where this site is in excellent condition, the most abundant decreasers are little bluestem, big bluestem, indiangrass, switchgrass, leadplant, catclaw sensitivebrier, Virginia tephrosia, slender lespedeza, and perennial sunflower.

Common increasers are tall dropseed, Scribner panicum, purpletop, purple lovegrass, heath aster, and goldenrod.

Figure 22.—**Excellent stand of native grasses on Eldorado soils in the Loamy Prairie range site was established by planting good quality seed and deferring grazing for two growing seasons.**

Plants that invade this site when there is prolonged overgrazing are broomsedge, splitbeard bluestem, ironweed, lanceleaf ragweed, western ragweed, and bitter sneezeweed. When overgrazing is continued, woody plants that appear and thicken include blackberry, coralberry, sumac, hawthorn, and persimmon. Spraying is often needed to control brush and restore growth of the better plants.

The potential yield of air-dry herbage ranges from 4,500 pounds per acre in years of favorable moisture to 3,500 pounds per acre in years of unfavorable moisture.

SHALLOW SAVANNAH RANGE SITE

This site consists of Hector soils that are typically shallow or very shallow, stony, and gently sloping to steep. These soils have a fine sandy loam surface layer that has good permeability, but the shallow profile limits available moisture capacity and root development.

The climax vegetation on this site is savannah—a mixture of scattered trees and tall grasses. The trees include blackjack oak, post oak, red oak, and hickory. The climax grasses are big bluestem, little bluestem, indiangrass, and switchgrass.

Poor management practices of overgrazing and annual burning cause an increase of brush on the site. Other increasers are purpletop, tall dropseed, Scribner panicum, goldenrod, and heath aster. Plants that invade the site after continued overgrazing include broomsedge bluestem, splitbeard bluestem, poverty oatgrass, ironweed, coralberry, sassafras, and persimmon.

Brush control is usually necessary to keep this site in good or excellent range condition.

The potential yield of air-dry herbage ranges from 4,500 pounds per acre in years of favorable moisture to 3,000 pounds per acre in years of unfavorable moisture.

SMOOTH CHERT SAVANNAH RANGE SITE

This site consists of deep, nearly level to moderately steep upland soils in the Baxter, Captina, Clarksville, Locust, Sallisaw, and Stigler series. The surface layer is silt loam to very cherty silt loam in most places. The subsoil is generally cherty and has a low to good available water

capacity. The Sallisaw soils are less cherty than the other soils on this site and have good available water capacity.

The climax vegetation is savannah, consisting of an open or scattered stand of post oak, white oak, red oak, blackjack oak, and shortleaf pine and an understory of tall grasses and forbs. Under good management the understory is big bluestem, little bluestem, indiangrass, switchgrass, slender lespedeza, tickclover, and perennial sunflower.

Where overgrazing and repeated annual burnings cause the site to deteriorate, woody plants, including blackjack oak, post oak, winged elm, persimmon, and sassafras, increase. Further deterioration results in an invasion of broomsedge bluestem, splitbeard bluestem, and poverty oatgrass. Brush control is usually needed to maintain the better grasses and improve the growth of forage on this site.

The potential yield of air-dry herbage ranges from 5,000 pounds per acre in years of favorable moisture to 3,500 pounds per acre in years of unfavorable moisture.

STEEP CHERT SAVANNAH RANGE SITE

Only Clarksville stony silt loam, 20 to 50 percent slopes, is in this site. Because this stony soil is rapidly permeable and has excessive runoff, the moisture available for plant growth is limited. The steep slope and stony surface make this site unsuitable for livestock grazing.

Under good management the vegetation consists of tall grasses in an open stand of trees. Decreaser plants are mainly big bluestem, little bluestem, indiangrass, slender lespedeza, and tickclover. Trees include post oak, blackjack oak, red oak, white oak, shortleaf pine, and black walnut. Shortleaf pine grows in small areas on south and west slopes.

When this site deteriorates, a brushlike growth of blackjack oak and post oak increases. Further deterioration results in an invasion of persimmon, sassafras, broomsedge bluestem, splitbeard bluestem, and poverty oatgrass. Control of undesirable brush is usually needed for substantial improvement of forage production on this site.

***Figure 23.*—Very shallow range site in good range condition on the very shallow Talpa soils. The underlying limestone limits moisture penetration, root development, and forage growth.**

The potential yield of air-dry herbage ranges from 4,500 pounds per acre in years of favorable moisture to 3,000 pounds per acre in years of unfavorable moisture.

VERY SHALLOW RANGE SITE

Only Talpa soils are in this site. These soils are very gently sloping to steep and very shallow to shallow. They have a stony surface layer that typically is 10 inches or less thick over limestone (fig. 23). Available moisture capacity and root growth are poor.

This site is dominated by plants that require little moisture for growth and reproduction. Under good management, these plants include side-oats grama, little bluestem, and hairy grama. This site usually supports numerous native legumes and forbs, such as Illinois bundleflower, catclaw sensitivebrier, prairie clovers, blacksamson, and compassplant. In a few places where crevices or pockets occur in the limestone bedrock, these soils are deep and support chinkapin oak and taller grasses representative of the Loamy Prairie range site.

Overgrazing results in increased amounts of silver bluestem, windmillgrass, dotted gayfeather, noseburn, pricklypear, beebalm, ragweed, and broomweed. Where the site is poorly managed, invaders include hawthorn, dogwood, winged elm, plum, sumac, and coralberry.

The potential yield of air-dry herbage ranges from 3,000 pounds per acre in years of favorable moisture to 1,500 pounds per acre in years of unfavorable moisture.

Woodland suitable for grazing

In addition to the rangeland in the two counties, some areas of woodland that are managed primarily for shortleaf pine and hardwoods also are important for grazing. In these woodland areas, the understory consists of grasses, forbs, and browse plants palatable to livestock (fig. 24).

The dominant decreaser plants on well-managed woodlands are big bluestem, little bluestem, indiangrass, switchgrass, Virginia tephrosia, hairy sunflower, tickclover, and slender lespedeza.

The plants that increase when heavy grazing is continuous include goldenrod, purpletop, Scribner panicum, meadow dropseed, and asters. Also increasing when grazing is heavy are persimmon, post oak, blackjack oak, and sassafras.

Plants that commonly invade these areas under excessive overgrazing are broomsedge bluestem, poverty oatgrass, puffsheath dropseed, ironweed, white snakeroot, and marestail.

Good grazing management is needed to maintain the desired plant growth and obtain economical livestock production.

Use of Soils as Woodland [6]

This part of the survey interprets the soils as woodland and tells how they can be managed so as to insure good growth of desired species.

About 59 percent of the two-county area is woodland. Nearly all of this woodland is privately owned, mostly in tracts of less than 200 acres.

The soils in the two counties differ in their suitability for growing trees. In areas of the very cherty and stony Clarksville soils, shortleaf pine grows on the south-facing slopes and on the tops of ridges. The north-facing slopes are largely occupied by black, red, and white oaks. The same kinds of oak, as well as walnut and sycamore, grow on the Sallisaw soils on foot slopes below the ridges. White and red oaks, sycamore, and black walnut grow on the more permeable soils of the drainageways. Water-tolerant oaks, some black walnut, and ash grow on the somewhat poorly drained Stigler soils on benches.

A few semipermanent sawmills operate in the two counties and cut timber for lumber and railroad crossties. Some of the local timber is processed in the survey area and in adjacent counties in Oklahoma, Arkansas, and Missouri.

When fire protection is improved and suitable management is planned, many wooded areas of the soils in the survey area could be expanded. The prohibition of grazing on open range has increased the potential for woodland. For a number of years, the Oklahoma Division of Forestry has maintained fire control and lookout towers in the survey area.

Woodland suitability groups of soils

About half of the soils in Cherokee and Delaware Counties have been placed in woodland suitability groups on the basis of their suitability to produce similar wood crops. Not placed in most woodland suitability groups are soils that are not suitable for the commercial production of wood crops. The soils in each woodland group require about the same kind of management. The mention of the series represented in the woodland groups does not mean that all the soils in the series mapped in the county are in the group. The soils in each woodland group can be determined by referring to the "Guide to Mapping Units" at the back of this survey. Explanations of the ratings and other terms used in these descriptions follow.

Productivity is expressed as site index and average yearly growth per acre. Site index is the average height, in feet, that the dominant and codominant trees of a given kind, growing on a specified soil, will reach at 50 years of age. The average annual growth in board feet (Doyle rule) is taken from standard growth tables for the specified tree species and is related to the average site index. Site index was determined by measuring the height of trees on each kind of soil in the two counties, and on the same kinds of soil in nearby counties. Average yearly growth is based on average rates over a 60-year period for pines and a 50-year period for oaks. These rates are given in board feet. A board foot is wood 1 foot square and 1 inch thick.

Seedling mortality refers to the expected loss of seedlings that results from unfavorable soil characteristics or unfavorable climate. Plant competition or accidental losses are not considered. The ratings are based on prob-

[6] Prepared with the assistance of CHARLES P. BURKE, woodland conservationist, Soil Conservation Service.

Figure 24.—**This area of Sallisaw silt loams is managed mainly for growth of pines, but it also provides grazing for livestock.**

able average losses of planted or naturally occurring seedlings.

Plant competition refers to the probable rate of invasion by unwanted kinds of trees and shrubs.

Equipment limitations are the result of soil and topographic features that restrict or prohibit use of conventional equipment, or that limit measures taken to establish, maintain, or harvest woodland stands. It may be necessary to consider a combination of unfavorable characteristics, such as rockiness and steep slopes.

Erosion hazard is an estimate of the probability of erosion damaging the soil, damaging roads and firebreaks, producing excessive sediment, or seriously damaging the woodland in other ways. It is assumed that the woodland is protected by satisfactory cover.

Landowners can obtain technical assistance in planning and applying conservation measures on their woodland through the local soil and water conservation district. Services for privately owned woodland are given by the Soil Conservation Service, the Extension Service, and the Forestry Division of the State Agriculture Department.

Following are descriptions of each woodland suitability group that include statements on production and management.

WOODLAND SUITABILITY GROUP 1

This group consists of deep, nearly level to very gently sloping soils that are in the Elsah, Osage, Staser, and Verdigris series. These soils are loamy or clayey and are gravelly in some places. They have rapid to very slow permeability and are excessively to somewhat poorly drained. These soils occur on bottom lands that are occasionally to frequently flooded.

On these soils the average site index for upland oaks is 70. Average yearly growth for upland oaks is 240 board feet per acre (Doyle rule).

Seedling mortality occurs only during extended droughts. Staser gravelly loam and, particularly, Elsah soils are too droughty in some years for satisfactory regeneration of trees.

Oaks on this group of soils survive the competition from undesirable trees and shrubs, but soil characteristics are favorable to the growth of all species, including the undesirable ones. Deadening timber so as to favor the desired trees is necessary.

On these soils cultural and harvesting operations can be carried out most of the year, but flooding and other excessive water severely limit use of equipment for a few

***Figure 25.*—Black walnut is a valuable commercial tree for specialty wood products and for the nut crop. This soil is Staser silt loam in woodland suitability group 1.**

days following rains. In many places accumulations of loose gravel limit use of equipment on Elsah soils.

Soil erosion is not a severe hazard on the soils of this group, but Elsah soils are unstable because they have a high content of gravel and are frequently flooded.

Red oak, white oak, sycamore, black walnut, and ash grow in natural stands and should be favored in management (fig. 25). Black walnut is suitable for planting on all the soils in this group.

Except for the Elsah soils, the soils in this group are suitable for post lots. Trees suitable for planting in post lots are black locust, catalpa, and Osage-orange.

WOODLAND SUITABILITY GROUP 2

This group consists of deep or moderately deep soils in the Baxter, Captina, Linker, and Sallisaw series. These soils are moderately well drained to well drained and have moderately slow to moderate permeability in their subsoil. They are nearly level to gently sloping and occur on uplands and stream terraces.

On the soils of this group the average site index is 60 for both shortleaf pine and upland oaks. The average yearly growth is 270 board feet per acre for the pine and 70 board feet for the upland oaks.

Seedling mortality is slight in natural and planted stands. The competition from undesirable woody plants is not generally severe on the soils of this group. If woodland weeding is practiced, the desired trees grow more rapidly. Except on the Linker fine sandy loam, use of equipment has only slight limitations.

Many soil areas in this group have been cleared for crops or pasture. Desirable native trees adapted to these soils are shortleaf pine, red oak, and white oak. Black locust is well adapted to these soils and grows more rapidly on them than on other soils in the two counties. Redcedar is suitable as fence posts and specialty lumber.

WOODLAND SUITABILITY GROUP 3

This group consists of very shallow to deep, loamy soils, some of which are cherty. These soils are in the Baxter, Hector, Locust, and Sallisaw series. They have moderately slow to moderately rapid permeability and are well

drained to somewhat excessively drained. These soils are very gently sloping to sloping and occur on stream terraces and uplands.

On these soils the average site index for both shortleaf pine and upland oaks is 55. The average yearly growth is 260 board feet per acre for shortleaf pine and 60 board feet for upland oaks.

Seedling mortality in native and planted stands is slight in years of average or more precipitation and moderate in dry years. The competition from undesirable woody plants is slight to moderate. Woodland weeding is often desirable where stands are established from natural or planted seedlings. The gravel and chert in some of these soils cause slight to moderate equipment limitations. Erosion is not a severe hazard on these soils.

Shortleaf pine, red oak, white oak, and redcedar are desirable trees that grow on the soils of this group (fig. 26). Black locust is suitable in post lots, and shortleaf pine and redcedar are suitable for planting in forests.

WOODLAND SUITABILITY GROUP 4

This group consists of deep stony or very cherty silt loams in the Clarksville series. These soils have rapid permeability and are somewhat excessively drained. They are very gently sloping to moderately steep and occur on uplands in the chert areas of the two counties.

On these soils the average site index is 50 for shortleaf pine and 55 for upland oaks. The average yearly growth per acre is 200 board feet for shortleaf pine and 60 board feet for upland oaks.

The competition from undesirable woody plants is more severe on the soils in this woodland group than on the soils in woodland group 3. Growth of trees is slowed in the frequently occurring moderately dry to severely dry periods. Some of the undesirable trees and brush withstand the frequent dry periods better than do the more valuable species. Woodland weeding is usually necessary in establishing and maintaining stands of forest trees.

Because of rockiness and slope, limitations to the use of equipment are at least moderately severe. Special care is necessary in locating and constructing logging and access roads and in constructing firebreaks. The erosion hazard is only slight.

Shortleaf pine, red oak, white oak, and redcedar grow well on these soils, though the cost of planting shortleaf pine is relatively high. The suitability of these soils for

Figure 26.—**Shortleaf pine grows on broad ridgetops and on south-facing slopes of Baxter, Captina, Locust, and Clarksville soils. This stand is on Baxter cherty silt loam, 1 to 3 percent slopes, in woodland suitability group 3.**

post-lot planting is questionable. Trees grow slowly, and stones and gravel make planting and cultivation difficult.

WOODLAND SUITABILITY GROUP 5

This group consists of only Stigler silt loam, 0 to 1 percent slopes. This soil has very slow permeability and is somewhat poorly drained. It occupies uplands and stream terraces.

On this soil upland oaks have an average site index of 50 and average yearly growth of 50 board feet per acre. Pine trees normally do not grow on this soil.

Seedling mortality ranges from slight to moderate and is greatest on terraces. Competition from undesirable trees and brush ranges from slight to moderate. Woodland weeding is a desirable practice, especially in upland areas.

Equipment limitation is slight, but in the level upland areas ponding delays forestry operations for several days following moderate to heavy rains. The erosion hazard is not more than slight.

Natural stands of timber contain many species. Growing on terraces are commercially valuable hardwoods, such as northern red oak, white oak, sycamore, and black walnut.

WOODLAND SUITABILITY GROUP 6

This group consists of deep to very shallow, strongly sloping to steep soils of the Clarksville, Hector, and Linker series. These soils have moderate to rapid permeability and are somewhat excessively drained. They occur on uplands.

On these soils the site index is 40 for shortleaf pine and 35 for upland oaks.

Seedling mortality is moderate to severe in both natural and planted stands, mainly because these soils are strongly sloping to steep and contain large amounts of rock.

Plant competition is severe. Several undesirable kinds of trees and brush compete with shortleaf pine and the more desirable kinds of oak. Because so little moisture is available, the desired trees do not grow well.

Equipment limitation is moderate to severe and increases as there is an increase in steepness of slope or in the amount of rock, or both. The harvesting of trees is nearly impractical in some areas of the Clarksville and Hector soils. In most places, the hazard of erosion is not more than moderate on the Clarksville soils but is severe on the Hector soils.

The soils of this group are not suitable for post lots. Shortleaf pine and redcedar grow on these soils, and the areas most suitable for trees may contain a few red and white oaks.

Planting trees in post lots on the prairie

In addition to the soils in woodland suitability groups, some of the soils of the prairie, with limitations, are suited to black locust and perhaps other species grown in post lots. These soils are in the Bates, Choteau, Dennis, Eldorado, Jay, Okemah, and Taloka series. If trees are planted in post lots on these soils, the species must be selected with care and special practices used for establishing and maintaining stands. Even with these practices, the growth of trees is slow.

The Soil Conservation Service and other agencies that cooperate with your soil and water conservation district will help you in selecting sites for post lots, in selecting seedlings, and in using good methods of planting and maintenance.

Wildlife and Fish [7]

The important kinds of wildlife in the survey area are bobwhite (quail), mourning dove, fox and gray squirrels, cottontail rabbit, deer, raccoon, mink, opossum, skunk, muskrat, and beaver. Wild turkey has been reestablished in small flocks. The main predators are coyote, bobcat, red fox, and gray fox. Predatory birds are hawks and owls of many different kinds. Large numbers of waterfowl and shore birds use the large lakes and the Arkansas River during migration.

A convenient way to discuss the wildlife and its habitat in the two counties is by soil associations. The six soil associations in the two counties are described in the section "General Soil Map" and are shown on the colored map at the back of this soil survey.

In the Sallisaw-Elsah-Staser (1) association are many water areas that were formed by flood-control reservoirs. The water areas have a moderate potential for producing fish and resting and feeding areas for waterfowl. The water is moderately fertile, and turbidity is not serious. The soils that are flooded support a woody cover and an understory of grass. They have a moderate potential for supplemental plantings that provide food and cover for deer, quail, turkey, and squirrel. The soils generally are fertile and deep enough to support trees, shrubs, forbs, and grasses needed by these animals and birds. The Elsah soils, however, are not suitable for cultivation. Sallisaw soils provide suitable sites for fish ponds.

The Eldorado-Newtonia-Okemah (2) and the Parsons-Dennis (6) associations consist of soils that support stands of prairie grasses. Small areas of trees and other woody plants grow along streams. Except for some areas of Eldorado soils, all the soils in these associations are tillable and have moderate potential for providing habitat for deer, quail, wild turkey, dove, and songbirds. These soils, however, have a low potential for squirrels because they cannot support enough oaks, hickory, and other trees that produce mast. Except for the Eldorado soils, the soils in these associations provide good sites for constructing fish ponds. Turbidity of the pond water is not excessive.

The Clarksville-Baxter-Locust association (3) consists of soils that support an oak-hickory forest type and have some understory of native grasses. Cultivation is limited because the soils are stony and steep. This association has moderate potential for deer, quail, wild turkey, squirrel, and songbirds. Mast trees, shrubs, forbs, and grasses are sufficient to provide needed habitat. The Baxter soils can be used for production of legumes, small grains, native forbs, grasses, and introduced shrubs. These soils also provide sites suitable for fish ponds, and the pond water is not excessively turbid.

The Baxter-Locust association (4) consists of soils that also support an oak-hickory forest type and an understory of grass. All of the major soils are tillable and have a high potential for producing plants that provide supplemental food and cover for wildlife. Among these plants are les-

[7] Prepared with the assistance of JEROME F. SYKORA, biologist, Soil Conservation Service.

pedezas, small grains, shrubs, and native forbs. Stigler soils are in this association and have the lowest potential for producing habitat for upland wildlife. This association provides suitable sites for constructing fish ponds. The potential for deer, quail, wild turkey, dove, and songbirds is high. Den and mast trees for squirrels are few.

The Hector-Linker association (5) consists of soils on which there is a cover of trees and native grasses. The cover ranges from dense stands of oak and hickory to more open savannah where grasses are more dominent. Scattered throughout the survey area are small areas of Linker soils that are suitable for wildlife habitat plantings. The more shallow Hector soils are steep and generally are unsuitable for plantings. Grasses and forbs, however, can be encouraged by applying herbicides and using mechanical practices. The potential for quail, deer, turkey, squirrel, and songbirds is high on the Hector-Linker association. Sites for small ponds are suitable on the Linker soils, and the water in these ponds is suitable for fish.

Use of Soils as Recreational Sites

In table 3 the soils of the two counties are rated according to the limitations to use for various facilities of outdoor recreation that depend on soil properties. Sallisaw soils, for example, have only slight limitations for use for most recreational sites (fig. 27, top).

Limitations are rated *slight*, *moderate*, *severe*, and *very severe*. A rating of slight indicates that the soil has few or no limitations and is considered desirable for the use named. A rating of moderate shows that a moderate problem is recognized, but it can be overcome or corrected. A rating of severe indicates that use of the soil is seriously limited by a hazard or restriction that is difficult to overcome. A rating of very severe indicates that use of the soil is very seriously limited by a hazard or restriction that is very difficult to overcome. A rating of severe or very severe for a particular use does not mean that a soil so rated cannot be put to that use.

TABLE 3.—*Estimated degree of soil limitations for recreational sites*

Mapping unit	Cottages and service buildings	Intensive campsites	Picnic areas	Athletic fields and other extensive play areas	Trails and paths	Golf fairways
Bates loam, 1 to 3 percent slopes [1]	Slight	Slight	Slight	Slight	Slight	Slight.
Baxter cherty silt loam, 1 to 3 percent slopes.	Moderate	Moderate	Slight	Moderate	Slight	Moderate.
Baxter-Locust complex, 3 to 5 percent slopes.	Slight	Slight	Slight	Moderate	Slight	Slight.
Baxter silt loam, 1 to 3 percent slopes	Moderate	Slight	Slight	Moderate	Slight	Slight.
Captina silt loam, 1 to 3 percent slopes	Moderate	Slight	Slight	Slight	Slight	Slight.
Choteau silt loam, 0 to 1 percent slopes [1]	Slight	Slight	Slight	Slight	Slight	Slight.
Choteau silt loam, 1 to 3 percent slopes [1]	Slight	Slight	Slight	Slight	Slight	Slight.
Clarksville stony silt loam, 5 to 20 percent slopes.	Moderate	Severe [2]	Severe [2]	Severe [2]	Moderate	Severe.[2]
Clarksville stony silt loam, 20 to 50 percent slopes.	Very severe [3]	Severe [2]	Severe [2]	Severe [2]	Severe [2]	Severe.[2]
Clarksville very cherty silt loam, 1 to 8 percent slopes	Slight	Slight	Moderate	Severe [2]	Moderate	Severe.[2]
Collinsville fine sandy loam, 2 to 5 percent slopes.[1]	Moderate	Moderate	Moderate	Severe [4]	Moderate	Severe.[4]
Dennis silt loam, 1 to 3 percent slopes [1]	Moderate	Slight	Slight	Moderate	Slight	Slight.
Eldorado silt loam, 1 to 3 percent slopes [1]	Slight	Slight	Slight	Slight	Slight	Slight.
Eldorado silt loam, 3 to 5 percent slopes [1]	Slight	Slight	Slight	Slight	Slight	Slight.
Eldorado soils, 3 to 12 percent slopes [1]	Moderate	Moderate	Moderate	Severe [2]	Moderate	Severe.[2]
Elsah soils	Very severe [5]	Severe [5]	Severe [5]	Very severe [5]	Severe [5]	Very severe.[5]
Hector fine sandy loam, 2 to 5 percent slopes.	Slight	Moderate	Slight	Severe [4]	Slight	Slight.
Hector-Linker association, hilly	Severe [3]	Very severe [2]	Severe [2]	Severe [2]	Severe [2]	Severe.[3]
Jay silt loam, 0 to 2 percent slopes	Moderate	Moderate	Moderate	Moderate	Slight	Slight.
Linker fine sandy loam, 2 to 5 percent slopes.	Slight	Slight	Slight	Slight	Slight	Slight.
Locust cherty silt loam, 1 to 3 percent slopes.	Moderate	Moderate	Slight	Moderate	Slight	Slight.
Newtonia silt loam, 0 to 1 percent slopes.[1]	Slight	Slight	Slight	Moderate	Slight	Slight.
Newtonia silt loam, 1 to 3 percent slopes.[1]	Slight	Slight	Slight	Moderate	Slight	Slight.
Newtonia silt loam, 3 to 5 percent slopes.[1]	Slight	Slight	Slight	Moderate	Slight	Slight.
Newtonia silt loam, 2 to 5 percent slopes, eroded.[1]	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate.
Okemah silt loam, 0 to 1 percent slopes [1]	Moderate	Slight	Slight	Moderate	Slight	Slight.
Okemah silty clay loam, 0 to 1 percent slopes.[1]	Severe [6]	Moderate	Slight	Moderate	Slight	Slight.
Okemah silty clay loam, 1 to 3 percent slopes.[1]	Severe [6]	Moderate	Slight	Moderate	Slight	Slight.

See footnotes at end of table.

TABLE 3.—*Estimated degree of soil limitations for recreational sites*—Continued

Mapping unit	Cottages and service buildings	Intensive campsites	Picnic areas	Athletic fields and other extensive play areas	Trails and paths	Golf fairways
Okemah silty clay loam, 3 to 5 percent slopes.[1]	Severe [6]	Moderate	Slight	Moderate	Slight	Slight.
Osage clay	Very severe [6]	Severe [7]	Severe [7]	Very severe [7]	Severe [7]	Severe.[7]
Parsons silt loam, 0 to 1 percent slopes [1]	Very severe [6]	Severe [7]	Moderate	Moderate	Slight	Slight.
Rough stony land [1]	Very severe [3]	Very severe [3]	Very severe [3]	Very severe [3]	Severe [3]	Very severe.[3]
Sallisaw gravelly silt loam, 1 to 3 percent slopes.	Slight	Slight	Slight	Moderate	Slight	Moderate.
Sallisaw gravelly silt loam, 3 to 8 percent slopes.	Slight	Slight	Slight	Moderate	Slight	Moderate.
Sallisaw silt loam, 0 to 1 percent slopes	Slight	Slight	Slight	Slight	Slight	Slight.
Sallisaw silt loam, 1 to 3 percent slopes	Slight	Slight	Slight	Slight	Slight	Slight.
Staser gravelly loam	Very severe [5]	Severe [5]	Severe [5]	Very severe [5]	Moderate	Severe.[5]
Staser silt loam	Very severe [5]	Severe [5]	Severe [5]	Very severe [5]	Moderate	Severe.[5]
Stigler silt loam, 0 to 1 percent slopes	Severe [6]	Severe [7]	Severe [7]	Severe [7]	Slight	Severe.[7]
Summit silty clay loam, 2 to 5 percent slopes, eroded.[1]	Severe [6]	Moderate	Moderate	Severe [3]	Moderate	Moderate.
Taloka silt loam, 0 to 1 percent slopes [1]	Severe [6]	Severe [7]	Slight	Slight	Slight	Slight.
Talpa-Rock outcrop complex, 2 to 8 percent slopes.[1]	Severe [2]	Very severe [2]	Severe [2]	Very severe [2]	Severe [2]	Severe.[2]
Talpa-Rock outcrop complex, 15 to 50 percent slopes.[1]	Severe [2]	Severe [2]	Moderate	Very severe [2]	Moderate	Very severe.[2]
Verdigris silt loam [1]	Very severe [5]	Severe [5]	Moderate	Severe [5]	Moderate	Severe.[5]
Verdigris soils, frequently flooded [1]	Very severe [5]	Severe [5]	Moderate	Severe [5]	Moderate	Severe.[5]
Woodson silt loam, 0 to 1 percent slopes [1]	Severe [6]	Moderate	Moderate	Moderate	Slight	Moderate.

[1] Very few trees.
[2] Cherty or stony soils.
[3] Steep soils.
[4] Shallow soils.
[5] Occasionally or frequently flooded.
[6] High shrink-swell potential.
[7] Periods of wetness.

Table 3 rates the degree of limitations if the soils are used for cottages and service buildings, campsites (tents and trailers), picnic areas (fig. 27, bottom), athletic fields and other intensive play areas, trails and paths, and golf fairways. Following are the main soil properties that limit use of soils for each recreational site:

COTTAGES AND SERVICE BUILDINGS: Poor drainage, flooding, seasonal high water table, and slope.

CAMPSITES (tents and trailers): Natural drainage, depth to seasonal high water table, soil permeability and texture, and slope.

PICNIC AREAS: Depth to seasonal high water table, slope, soil texture and permeability, and flooding.

ATHLETIC FIELDS AND OTHER INTENSIVE PLAY AREAS: Natural drainage, soil permeability and stability, depth to seasonal high water table, soil texture, and slope.

TRAILS AND PATHS: Natural drainage, flooding, soil texture and permeability, stability, and slope.

GOLF FAIRWAYS: Depth to seasonal high water table, slope, soil texture, and flooding.

Engineering Uses of Soils [8]

Some soil properties are of special interest to engineers because they affect the construction and maintenance of roads, airports, pipelines, foundations of buildings, facilities for water storage, structures for erosion control, drainage systems, and sewage disposal systems. Among the properties most important to engineers are permeability to water, shear strength, compaction characteristics, soil drainage, shrink-swell potential, grain size, plasticity, and reaction (pH).

The information in this soil survey can be used by engineers to—

1. Make studies of soil and land use that will aid in selecting and developing sites for industrial, business, residential, and recreational uses.
2. Make preliminary estimates of the engineering properties of soils that affect the planning of agricultural drainage systems, farm ponds, irrigation systems, terraces, and waterways.
3. Make preliminary evaluations of soils and ground conditions that will aid in selecting locations for highways, airports, pipelines, and cables and in planning detailed investigations of the selected locations.
4. Locate probable sources of gravel and other material used in construction.
5. Correlate performance of engineering structures with soil mapping units and thus develop information that will be useful in designing and maintaining the structures.
6. Determine the suitability of soils for cross-country movement of vehicles and construction equipment.

[8] Prepared with the assistance of ROBERT F. HEIDLAGE, agricultural engineer, Soil Conservation Service, and WILLIAM E. HARDESTY, civil engineer, Soil Conservation Service.

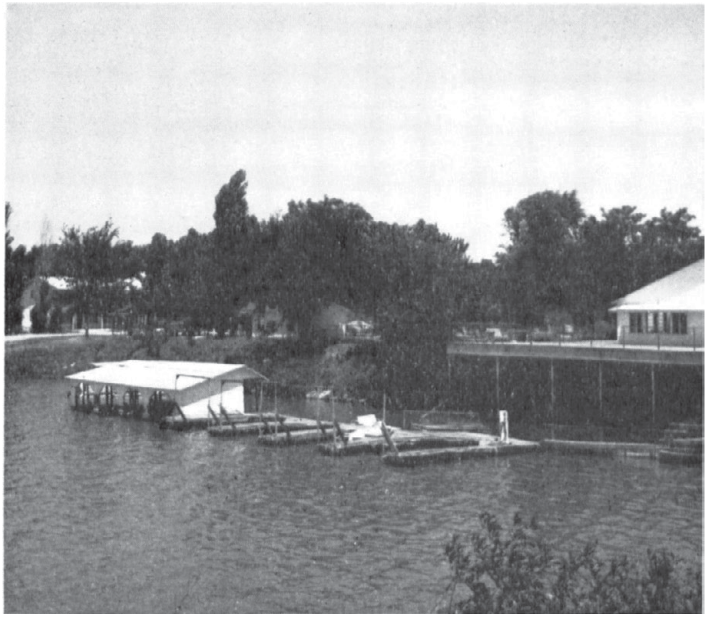

Figure 27.—Top: **Sallisaw soils furnish excellent sites for building recreational facilities.** ***Bottom:*** **Picnic area on Clarksville soils.**

7. Supplement the information obtained from other published maps, reports, and aerial photographs for the purpose of making maps and reports that can be used readily by engineers.
8. Develop other preliminary estimates for construction purposes pertinent to the particular area.

The engineering interpretations reported here can be useful for many purposes. It should be emphasized that they may not eliminate the need for sampling and testing at the site of specific engineering works that involve heavy loads or where the excavations are deeper than the depth of the layers reported. Even in these situations, however, the soil map is useful for planning more detailed field investigations and for suggesting the kinds of problems that may be expected.

Most of the information in this section is given in tables 4, 5, and 6. In table 4 are estimates of soil properties significant to engineering. Table 5 gives engineering interpretations of the soils, and table 6 lists data obtained when samples of selected soils were tested in the laboratory. Additional information useful to engineers can be found in other sections of this survey, particularly "Descriptions of the Soils" and "Formation and Classification of Soils."

Some of the terms used by the soil scientist may not be familiar to the engineer, and some commonly used terms may have a special meaning in soil science. Several of these terms are defined in the Glossary at the back of this soil survey.

Engineering classification systems

The two systems most commonly used in classifying samples of soil horizons for engineering are the AASHO system adopted by the American Association of State Highway Officials (*1*) and the Unified system used by engineers in the Soil Conservation Service (*7*).

The AASHO system is used to classify soils according to those properties that affect use in highway construction. In this system, a soil is placed in one of seven basic groups on the basis of grain-size distribution, liquid limit, and plasticity. These groups range from A–1 to A–7. In group A–1 are gravelly soils of high bearing strength, or the best soils for road subgrade (foundation) and, in group A–7 are clay soils that have low strength when wet and are the poorest for subgrade. Where laboratory data are available, the seven basic groups are further divided into subgroups that indicate more precisely the nature of the soil material. If soil material is near a classification boundary, both applicable symbols are shown. Within each group, the relative engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 for the poorest. The AASHO classification for tested soils, with index numbers in parentheses, is shown in table 6.

In the Unified system soils are classified according to particle size, plasticity, liquid limit, and organic-matter content. Soils are identified as gravels (G), sands (S), silts (M), clays (C), organic (O), and highly organic (Pt). Clean sands are identified by the symbols SW and SP; sands mixed with fines of silt and clay are SM and SC; silts and clays that have a low liquid limit are ML and CL; and silts and clays that have a high liquid limit are MH and CH.

Estimated engineering properties of the soils

Table 4 provides estimates of soil properties important to engineering. The estimates are based on field classification, the descriptions of the soils, data from laboratory tests of selected samples, test data from comparable soils in adjacent areas, and experience in working with the individual kind of soil in the survey area. Rough stony land has such variable properties that it is not listed in table 4.

TABLE 4.—*Estimated engineering*

Soil series and map symbols	Depth to hard bedrock	Depth from surface of typical profile	Classification		
			USDA texture	Unified	AASHO
	Inches	*Inches*			
Bates (BaB)	20–40	0–12	Loam	ML or CL	A–4
		12–30	Clay loam	CL	A–6
		30	Sandstone		
Baxter (BcB, BhB, BlC) (For properties of the Locust soil in unit BlC, refer to the Locust series.)	>7	0–9	Silt loam or cherty silt loam	ML	A–4
		9–22	Silty clay loam to cherty silty clay loam.	CL or ML	A–7 or A–6
		22–34	Cherty clay	CL or CH	A–6 or A–7
		34–60	Very cherty clay	GC or ML–CL	A–6 or A–2
Captina (CaB)	>72	0–7	Silt loam	ML	A–4
		7–50	Silty clay loam	CL	A–6
Choteau (ChA, ChB)	>72	0–24	Silt loam	ML	A–4
		24–49	Silty clay loam	CL	A–6
Clarksville (CkD, ClE, ClF)	>72	0–10	Stony silt loam or very cherty silt loam.	ML or GM	A–4
		10–40	Very stony silty clay loam	GM or GC	A–2 or A–4
		40–60	Mostly chert beds		
Collinsville (CoC)	8–20	0–13	Fine sandy loam	ML	A–4
		13	Sandstone		
Dennis (DnB)	>72	0–13	Silt loam	ML	A–4
		13–34	Silty clay loam	MH–CH	A–6 or A–7
		34–66	Silty clay loam	CH	A–6 or A–7
Eldorado (EdB, EdC, ElD)	>72	0–11	Silt loam or cherty silt loam	ML	A–4
		11–22	Silty clay loam or very cherty silt loam.	ML–CL or GM	A–2 or A–4
		22–63	Very cherty silty clay loam	GM or ML	A–2 or A–7
Elsah (Es)	>72	0–60	Very gravelly loam	GM	A–1 or A–2
Hector (HcC, HlE) (For properties of the Linker soil in unit HlE, refer to the Linker series.)	8–20	0–15	Fine sandy loam	SM or ML	A–2 or A–4
		15	Sandstone		
Jay (JaA)	>72	0–13	Silt loam	ML	A–4
		13–26	Silty clay loam	ML	A–4
		26–70	Silty clay loam	ML–CL	A–4 or A–6
Linker (LkC)	20–40	0–6	Fine sandy loam	SM or ML	A–2 or A–4
		6–11	Loam	ML or CL	A–4
		11–39	Clay loam	CL	A–4 or A–6
		39	Sandstone		

properties of the soils

Percentage passing sieve—				Available water capacity	Reaction	Shrink-swell potential	Permeability (least permeable layer)	Corrosivity	
No. 4	No. 10	No. 40	No. 200					Uncoated steel	Concrete
				Inches per inch of soil	*pH value*		*Inches per hour*		
90–100	90–100	90–100	75–90	0. 14	5. 6–6. 5	Low	06. 3–2. 0	Moderate	Moderate.
90–100	90–100	90–100	75–95	0. 17	5. 1–6. 0	Low to moderate			
						Very low			
80–95	80–100	75–98	60–95	0. 14	5. 1–6. 0	Low	0. 20–0. 63	Moderate	Moderate to high.
60–95	60–100	60–98	60–95	0. 14	4. 5–5. 5	Low to moderate			
60–75	60–75	55–75	50–70	0. 12	4. 5–5. 5	Low to moderate			
20–75	20–65	20–60	20–55	0. 08	4. 5–5. 5	Low			
90–100	90–100	90–100	75–90	0. 14	5. 1–6. 0	Low	0. 20–0. 63	Moderate	Moderate to high.
85–100	85–100	85–100	65–90	0. 17	4. 5–6. 0	Moderate			
100	100	90–100	75–90	0. 14	5. 6–6. 5	Low	0. 20–0. 63	Moderate	Moderate.
100	100	90–100	85–95	0. 17	5. 1–7. 8	Moderate			
40–70	40–70	40–70	40–70	0. 08	5. 1–6. 5	Low	6. 3–10. 0	Low to moderate.	Moderate to high.
10–50	10–50	10–50	10–50	0. 06	4. 5–5. 5	Low			
10–50	10–50	10–50	10–50	0. 05	4. 5–5. 5	Very low			
90–100	90–100	85–95	60–80	0. 12	5. 1–6. 0	Low	2. 0–6. 3	Low	Moderate.
						Very low			
100	100	90–100	75–95	0. 14	6. 1–7. 3	Low	0. 06–0. 20	High	Low to moderate.
100	100	90–100	85–95	0. 17	5. 1–6. 5	Moderate to high			
100	100	90–100	75–95	0. 17	5. 1–7. 8	Moderate to high			
70–100	70–100	70–95	60–90	0. 14	5. 6–6. 5	Low	2. 0–6. 3	Low to moderate.	Moderate to high.
30–98	30–90	30–90	30–85	0. 05–0. 14	4. 5–6. 0	Low to moderate			
15–65	15–65	15–65	15–65	0. 05–0. 14	4. 5–6. 0	Very low			
10–35	10–35	10–35	10–35	0. 05	5. 6–7. 3	Very low	6. 3–20. 0	Low	Low to moderate.
90–100	90–100	85–95	30–60	0. 10	5. 1–6. 5	Very low	2. 0–6. 3	Low	Low to moderate.
						Very low			
100	100	90–100	75–95	0. 14	5. 1–6. 0	Low	0. 06–0. 20	High	Moderate to high.
100	90–100	90–100	85–95	0. 17	4. 5–5. 5	Moderate			
100	90–100	90–100	85–95	0. 17	4. 5–6. 5	Moderate			
100	90–100	90–100	30–60	0. 12	4. 5–6. 0	Low	0. 63–2. 0	Moderate	Moderate to high.
100	90–100	90–100	55–85	0. 14	4. 5–6. 0	Low			
100	100	90–100	85–95	0. 17	4. 5–6. 0	Moderate			
						Very low			

TABLE 4.—*Estimated engineering*

Soil series and map symbols	Depth to hard bedrock	Depth from surface of typical profile	Classification		
			USDA texture	Unified	AASHO
	Inches	*Inches*			
Locust (LoB)	>72	0–16	Cherty silt loam	ML	A–4
		16–42	Cherty silty clay loam	ML–CL	A–4 or A–6
Newtonia (NaA, NaB, NaC, NaC2)	>72	0–16	Silt loam	ML	A–4
		16–26	Silty clay loam	ML–CL	A–4 or A–6
		26–60	Silty clay loam	CL or CH	A–6
Okemah (OeA, OkA, OkB, OkC)	>72	0–20	Silt loam or silty clay loam	ML	A–4 or A–6
		20–60	Silty clay	CL or CH	A–7
Osage (Os)	>72	0–60	Clay	CH or MH	A–7
Parsons (PaA)	>72	0–12	Silt loam	ML	A–4
		12–39	Clay	CH or CL	A–7
		39–60	Silty clay loam	ML or CH	A–7 or A–6
Sallisaw (SaA, SaB, SgB, SgD)	>72	0–18	Silt loam or gravelly silt loam	ML	A–4
		18–32	Silty clay loam to gravelly silty clay loam.	ML–CL	A–4 or A–6
		32–63	Very gravelly silty clay loam	GM or GC	A–2 or A–4
Staser (Sm, Sn)	>72	0–24	Silt loam or gravelly loam	ML	A–4
		24–43	Silt loam or gravelly silt loam	ML or GM	A–4
		43–60	Very gravelly loam	ML or GM	A–1 or A–4
Stigler (SrA)	>72	0–18	Silt loam	ML–CL	A–4
		18–65	Silty clay loam	ML or CL	A–6 or A–7
Summit (SuC2)	40–72	0–17	Silty clay loam	ML	A–4 or A–6
		17–48	Silty clay	CH or MH	A–7
		48	Limestone		
Taloka (TkA)	>72	0–22	Silt loam	ML	A–4
		22–49	Silty clay	ML–CL	A–6 or A–7
		49–60	Silty clay loam	CL	A–4 or A–6
Talpa (TrD, TrF)	2–15	0–9	Silty clay loam	ML–CL	A–6
		9–20	Limestone		
Verdigris (Vd, Vr)	>72	0–24	Silt loam	ML	A–4
		24–60	Silty clay loam	ML	A–4 or A–6
Woodson (WoA)	>72	0–10	Silt loam	ML	A–4
		10–60	Silty clay	CL or CH	A–7

properties of the soils—Continued

Percentage passing sieve—				Available water capacity	Reaction	Shrink-swell potential	Permeability (least permeable layer)	Corrosivity	
No. 4	No. 10	No. 40	No. 200					Uncoated steel	Concrete
				Inches per inch of soil	*pH value*		*Inches per hour*		
70–85	70–85	70–85	55–80	0.12	5.1–6.0	Low	0.20–0.63	Moderate	Moderate to high.
60–80	60–80	60–80	50–70	0.14	4.5–5.5	Low to moderate			
100	100	100	75–90	0.14	5.6–6.5	Low	0.63–2.0	Moderate	Moderate.
100	100	100	85–95	0.17	5.1–6.0	Moderate			
70–90	70–90	70–90	70–90	0.17	5.1–6.0	Moderate			
100	100	90–100	85–95	0.17	5.6–6.5	Moderate	0.06–0.20	High	Low to moderate.
100	100	90–100	90–98	0.17	5.6–8.4	High	0.06–0.20		
100	100	100	90–98	0.17	6.1–7.8	Very high	<0.06	High	Low.
100	100	90–100	75–95	0.14	5.1–6.0	Low	<0.06	High	Low to moderate.
100	100	90–100	90–98	0.17	5.6–7.3	High			
100	100	90–100	85–95	0.17	6.1–8.4	Moderate to high			
70–95	70–95	70–95	60–80	0.14–0.10	5.6–6.5	Low	0.63–2.0	Low to moderate.	Moderate to high.
65–95	65–95	65–95	50–90	0.17–0.12	4.5–6.0	Low to moderate			
20–40	20–40	20–40	20–40	0.08	4.5–6.0	Low			
70–100	70–100	70–100	60–80	0.10–0.14	6.1–7.3	Low	2.0–6.3	Low	Low to moderate.
50–95	50–95	50–95	40–80	0.10–0.14	5.6–7.3	Low			
20–80	20–80	20–80	20–80	0.05	5.6–7.3	Very low			
90–100	90–100	90–100	75–90	0.14	5.1–6.0	Low	<0.06	High	Moderate to high.
90–100	90–100	90–100	85–95	0.17	4.5–7.8	Moderate to high			
100	100	90–100	85–95	0.17	5.6–7.3	Moderate	0.06–0.20	High	Low to moderate.
100	100	90–100	90–98	0.15	6.1–8.4	High			
100	90–100	90–100	85–98	0.14	5.1–6.0	Low	<0.06	High	Low to moderate.
95–100	90–100	80–98	80–98	0.17	5.6–7.3	High			
95–100	90–100	80–98	80–98	0.17	5.6–7.3	Moderate to high			
90–100	90–100	90–100	85–95	0.17	6.1–7.3	Moderate	0.2–0.63	Low to moderate.	Low.
100	90–100	90–100	75–90	0.14	5.6–7.3	Low	0.2–0.63	Low	Low to moderate.
100	90–100	90–100	85–95	0.17	5.6–7.3	Moderate			
100	95–100	95–100	75–90	0.14	5.6–6.5	Low	<0.06	High	Low to moderate.
95–100	95–100	95–100	90–98	0.17	6.1–8.4	High			

TABLE 5.—*Engineering*

Soil series and map symbol	Suitability as source of—		Soil features affecting—		
	Topsoil	Road fill	Highway location	Farm ponds	
				Reservoir area	Embankment
Bates (BaB)	Good	Fair to poor: A–4 in surface layer; A–6 in subsoil.	Some lateral seepage.	Moderately shallow to sandstone.	Fair stability and compaction; borrow material limited.
Baxter (BcB, BhB, BlC) (For properties of the Locust soil in unit BlC, refer to the Locust series.)	Fair: some gravel-size chert.	Good to poor: A–6 or A–7 in subsoil of silt loam (BcB); good in cherty silt loam (BhB).	Features favorable.	Chert beds locally below depth of 3 feet; may leak.	Features favorable.
Captina (CaB)	Fair: steep slopes erodible.	Fair: A–4 in surface layer; A–6 in subsoil.	Features favorable.	Chert beds locally below depth of 3 feet; may leak.	Features favorable.
Choteau (ChA, ChB)	Fair to good: steep slopes erodible.	Fair to poor: A–4 in surface layer; A–6 in subsoil.	Deep, unstable foundation.	Features favorable.	Features favorable.
Clarksville (CkD, ClE, ClF).	Poor: stony or cherty.	Poor to fair: in many places not enough fines to fill voids among stones.	Steep slopes; dense chert beds at depth of 2 to 6 feet.	Chert beds below depth of 2 feet are pervious. [1]	Material over chert beds limited.
Collinsville (CoC)	Poor: material limited.	Poor: material limited over sandstone.	Sandstone bedrock at depth of about 1 foot.	Sandstone at depth of about 1 foot.	Material over sandstone limited.
Dennis (DnB)	Good in surface layer.	Poor: A–4 in surface layer; A–6 or A–7 in subsoil.	Moderate to high shrink-swell potential.	Features favorable.	Fair stability and compaction.
Eldorado (EdB, EdC, ElD)	Good to poor: some areas too cherty or stony.	Good: A–4 in surface layer; A–2 in subsoil.	Some strong slopes.	Porous, stony subsoil locally; strong slopes.	Porous, stony subsoil.
Elsah (Es)	Poor: mostly gravel.	Good: A–1 or A–2	Frequent overflow	Very pervious	Very pervious
Hector (HcC, HlE) (For properties of the Linker soil in unit HlE refer to the Linker series.)	Poor: shallow soil over sandstone.	Poor: bedrock at depth of about 1 foot.	Steep slopes; bedrock near surface.	Steep slopes; bedrock near surface.[2]	Borrow material limited.
Jay (JaA)	Good: large quantity; steep slopes easily eroded.	Fair: A–4 in surface layer; A–4 or A–6 in subsoil.	Deep, unstable subsoil.	Features favorable	Features favorable
Linker (LkC)	Fair to good	Fair: A–2 or A–4 in surface layer; A–4 or A–6 in subsoil.	Features favorable except for some steep slopes.	Some areas of thick sandstone at depth of about 4 feet.	Features favorable
Locust (LoB)	Poor: cherty	Fair to good: A–4 in surface layer; A–4 or A–6 in subsoil; soil cherty.	Features favorable	Chert beds locally below 3 feet; may leak.	Features favorable

See footnotes at end of table.

interpretations of the soils

Soil features affecting—Continued					Soil limitations for sewage disposal		Hydrologic soil group
Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways	Foundations for low buildings (three stories or less)	Septic tank filter fields	Sewage lagoons	
Well drained; seasonal seepy spots.	Restricted root zone; sloping.	Moderately erodible.	Moderately erodible.	Features favorable where foundations are on sandstone.	Moderate to severe: sandstone at about 3 feet.	Slight	B
Well drained	Gentle slopes	Features favorable.	Features favorable.	Features favorable for cherty silt loam (BhB); moderate shrink-swell potential.	Moderate to severe: slow percolation rate.	Slight	B
Well drained	Features favorable.	Features favorable.	Features favorable.	Moderate shrink-swell potential.	Slight	Slight	B
Well drained	Features favorable.	Features favorable.	Features favorable.	Deep, unstable subsoil.	Severe: slow percolation rate.	Slight	C
Well to excessively drained	Steep slopes; low available water capacity; mostly nonarable.	Mostly nonarable.	Mostly nonarable.	Features favorable, except for steep slopes.	Severe: steep slopes; lateral seepage; chert beds at depth of 2 to 6 feet.	Very severe: steep slopes; very permeable.	B
Well drained	Shallow soil over sandstone.	Nonarable	Nonarable	Features favorable.	Very severe: sandstone at depth of about 1 foot.	Very severe: sandstone at depth of about 1 foot.	C
Well drained	Slow intake rate; sloping.	Features favorable.	Features favorable.	Moderate to high shrink-swell potential.	Severe: slow percolation rate.	Slight	C
Well drained	Sloping; coarse fragments; low available water capacity.	Stony and sloping in some places.	Stony and sloping in some places.	Features favorable.	Moderate: stony subsoil; sloping.	Severe: porous and sloping.	D
Excessively drained.	Nonarable	Nonarable	Nonarable	Flooding	Severe: flooding.	Severe: flooding; high permeability.	A
Well drained	Nonarable	Nonarable	Nonarable	Steep slopes	Severe: steep slopes; bedrock at epth of about 1 foot.	Very severe: steep slopes; permeability.	C
Moderately well drained.	Features favorable.	Features favorable.	Features favorable.	Deep, unstable subsoil.	Severe: slow percolation rate.	Slight	C
Well drained	Features favorable except for slope.	Strong slopes; other features favorable.	Features favorable.	Features favorable.	Severe: bedrock at depth of 2 to 4 feet.	Moderate to severe: slopes; pervious surface.	B
Well drained	Gentle slopes	Features favorable.	Features favorable.	Features favorable.	Moderate to severe: slow percolation rate.	Slight to moderate: sloping.	B

TABLE 5.—*Engineering*

Soil series and map symbol	Suitability as source of—		Soil features affecting—		
	Topsoil	Road fill	Highway location	Farm ponds	
				Reservoir area	Embankment
Newtonia (NaA, NaB, NaC, NaC2).	Good	Poor to fair: A-4 to A-6.	Features favorable	Pervious material.[1]	Features favorable with compaction.
Okemah (OeA, OkA, OkB, OkC).	Fair for silty clay loams (OkA, OkB, OkC); good for silt loam (OeA).	Poor: A-4 or A-6 in surface layer; A-7 in subsoil.	Unstable clayey subsoil.	Features favorable except bedrock at depth of 3 feet.	Features favorable
Osage (Os)	Poor: clay	Poor: A-7 profile; high shrink-swell potential.	Unstable clay; flood hazard.	Features favorable	Unstable clay; low shear strength; cracks when dry.
Parsons (PaA)	Poor: clay subsoil at depth of 1 foot.	Poor: high shrink-swell potential; A-4 in surface layer; A-7 in subsoil.	High shrink-swell potential; seasonal high water table; unstable subsoil.	Features favorable	Poor stability
Sallisaw (SaA, SaB, SgB, SgD).	Fair to good: some areas gravelly.	Good	Features favorable.	Pervious at lower depths.[1]	Features favorable.
Staser (Sm, Sn)	Fair to good: some areas gravelly.	Good except for flooding.	Flooding	Pervious at lower depths.	Features favorable.
Stigler (SrA)	Fair: steep slopes easily eroded.	Poor: A-4 in surface layer; A-6 or A-7 in subsoil.	Moderate to high shrink-swell potential; seasonal high water table.	Features favorable.	Features favorable.
Summit (SuC2)	Good	Poor: A-4 or A-6 in surface layer; A-7 in subsoil.	Unstable clayey subsoil.	Features favorable except depth limited in local areas.	Poor stability
Taloka (TkA)	Fair to good: steep slopes erodible.	Poor: moderate to high shrink-swell potential; A-4 in surface layer; A-7 in subsoil.	Moderate to high shrink-swell potential; seasonal high water table; unstable subsoil.	Features favorable.	Poor stability
Talpa (TrD, TrF)	Poor: shallow soil over limestone.	Poor: shallow soil over limestone.	Limestone near surface; slopes range from gentle to very steep.	Limestone near surface.[2]	Borrow material limited; steep slopes.
Verdigris (Vd, Vr)	Good: large quantities; steep slopes.	Fair to good: A-4 material.	Some flood hazard.	Features favorable.	Features favorable.
Woodson (WoA)	Poor: clay subsoil at depth of 1 foot.	Poor: high shrink-swell potential; A-4 in surface layer; A-7 in subsoil.	High shrink-swell potential; unstable subsoil.	Features favorable.	Poor stability

[1] Detailed onsite investigation essential because in many places substratum is too pervious to hold water.

interpretations of the soils—Continued

Soil features affecting—Continued					Soil limitations for sewage disposal		Hydrologic soil group
Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways	Foundations for low buildings (three stories or less)	Septic tank filter fields	Sewage lagoons	
Well drained	Features favorable; gently sloping.	Features favorable.	Features favorable.	Features favorable.	Slight	Moderate to severe: pervious material.	B
Slow internal drainage.	Slow intake rate; gently sloping.	Features favorable.	Features favorable.	Moderate to high shrink-swell potential.	Severe: slow percolation rate.	Slight	C
Very slow internal drainage; flooding.	Low intake rate; slow internal drainage; flooding.	Nearly level; flooding.	Nearly level; flooding.	High shrink-swell potential; flooding.	Severe: flood hazard; slow percolation rate.	Severe: flooding.	D
Somewhat poorly drained; seasonal high water table.	Very slow intake rate; somewhat poorly drained; surface soil limited.	Nearly level; very slow permeability.	Nearly level; droughty; shallow surface layer over clay.	High shrink-swell potential; seasonal high unstable subsoil.	Severe: seasonal high water table; slow percolation rate.	Slight	D
Well drained	Slopes in some areas.	Features favorable.	Features favorable.	Features favorable.	Slight	Slight to severe: gravelly type too pervious.	B
Well drained; flooding.	Flooding	Nearly level; flooding.	Nearly level	Flooding	Severe: flooding.	Severe: flooding.	B
Somewhat poorly drained.	Somewhat poorly drained.	Nearly level	Nearly level	Moderate to high shrink-swell potential; unstable subsoil.	Severe: seasonal high water table; slow percolation rate.	Slight	D
Moderately well drained.	Slow intake rate; sloping.	Features favorable.	Features favorable.	Moderate to high shrink-swell potential.	Severe: slow percolation rate.	Slight to moderate: sloping.	C
Somewhat poorly drained; seasonal high water table.	Dense clay subsoil at depth of 2 feet.	Nearly level	Features favorable.	High shrink-swell potential; seasonal high water table; unstable subsoil.	Severe: seasonal high water table; slow percolation rate below depth of 2 feet.	Slight	D
Well drained	Nonarable	Nonarable	Nonarable	Features favorable.	Severe: limestone near surface.	Very severe: steep slopes; shallow soils.	D
Well drained; flood hazard.	Some flooding; other features favorable.	Nearly level; some flooding.	Nearly level	Some flooding; other features favorable.	Severe: flood hazard.	Severe: flood hazard.	B
Somewhat poorly drained.	Very slow intake rate.	Nearly level; very slow permeability.	Nearly level; droughty; shallow surface layer over clay.	High shrink-swell potential; seasonal high water table; unstable subsoil.	Severe: seasonal high water table; slow percolation rate.	Slight	D

[2] Soil is too shallow over bedrock to be practical for pond use.

351-985—70——5

TABLE 6.—*Engineering*

[Tests performed by the Oklahoma Department of Highways in accordance with standard

Soil name and location	Parent material	Oklahoma report No.	Depth	Shrinkage		
				Limit	Ratio	Volume change from field moisture equivalent
			Inches			*Percent*
Baxter silt loam: 700 feet north and 30 feet east of southwest corner, section 25, T. 22 N., R. 24 E., Delaware County.	Cherty limestone (Mississippian).	SO-5355	0-12	[4] NP	[4] NP	[4] NP
		SO-1838	16-28	13	1. 91	47
		SO-1839	28-42	16	1. 79	31
Dennis silt loam: 300 feet east and 60 feet north of southwest corner, section 8, T. 25 N., R. 22 E., Delaware County.	Sandstone and shale (Pennsylvanian).	SO-5349	0-12	21	1. 68	14
		SO-5350	18-24	12	1. 96	58
		SO-5351	36-56	11	1. 94	62
Eldorado silt loam: 500 feet east and 100 feet north of southwest corner, section 28, T. 25 N., R. 22 E., Delaware County.	Cherty limestone.	SO-5346	0-9	22	1. 70	7
		SO-1835	15-20	18	1. 75	15
		SO-1836	23-40	14	1. 82	60
Jay silt loam: 300 feet west and 100 feet north of southeast corner, section 8, T. 17 N., R. 22 E. (modal), Cherokee County.	Alluvium.	SO-9071	0-6	25	1. 48	13
		SO-9072	28-48	18	1. 76	14
		SO-9073	48-62	17	1. 77	23
Parsons silt loam: 1,000 feet east and 60 feet north of southwest corner, section 29, T. 25 N., R. 22 E., Delaware County.	Clayey alluvium.	SO-5343	0-8	21	1. 64	4
		SO-1834	10-18	11	1. 93	67
		SO-5345	30-40	15	1. 84	40
Stigler silt loam: Center of NE¼ of the SW¼, section 25, T. 17 N., R. 22 E. (modal), Cherokee County.	Loamy and clayey alluvium.	SO-9077	0-10	25	1. 56	8
		SO-9078	21-32	14	1. 87	46
		SO-9079	32-48	13	1. 92	47
Taloka silt loam: 2,000 feet east and 300 feet north of southwest corner, section 8, T. 17 N., R. 22 E. (modal), Cherokee County.	Clayey alluvium.	SO-9074	0-12	24	1. 60	11
		SO-9075	21-36	20	1. 85	25
		SO-9076	36-44	15	1. 88	3 2

[1] Mechanical analyses according to the AASHO Designation T88. Results by this procedure frequently may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes for soil.

Information on the depth to seasonal high water table has been omitted from table 4 because most of the soils of Cherokee and Delaware Counties do not have a seasonal high water table. A perched water table occurs at a depth of about 1 foot in the Parsons soils, about 1½ feet in the Stigler soils, and 1½ to 2 feet in the Taloka soils. The Elsah, Osage, Staser, and Verdigris soils are periodically flooded.

The United States Department of Agriculture defines texture as the proportion of sand, silt, and clay in soil material. Sand, silt, clay, and some of the other terms used in the USDA classifications are defined in the Glossary of this soil survey.

Available water capacity (available moisture capacity) is that amount of capillary water in the soil available for plant growth after all free water has drained away. It is the amount of moisture held in soil between field capacity, or about one-third atmosphere of tension, and the wilting coefficient, or about 15 atmospheres of tension.

Reaction is the degree of acidity or alkalinity of a soil, expressed as a pH value. The pH of a neutral soil is 7.0, of an acid soil is less than 7.0, and of an alkaline soil is more than 7.0.

Shrink-swell potential is the volume change to be expected of the soil material with changes in moisture con-

test data

procedures of the American Association of State Highway Officials (AASHO) (*1*)]

Mechanical analysis [1]										Liquid limit	Plasticity index	Classification	
Percentage passing sieve						Percentage smaller than—						AASHO [2]	Unified [3]
1-in.	¾-in.	⅜-in.	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.005 mm.	0.002 mm.				
------	------	------	------	100	97	93	84	17	10	[4] NP	[4] NP	A-4(8)	ML
------	------	------	------	100	96	92	86	36	31	43	17	A-7-6(12)	ML-CL
[5] 91	------	------	74	63	57	51	47	18	15	36	13	A-6(4)	ML-CL
------	------	------	------	100	98	92	80	18	13	30	5	A-4(8)	ML
------	------	------	------	100	99	95	88	49	43	60	29	A-7-5(20)	MH-CH
------	------	------	------	100	99	95	80	42	37	59	34	A-7-6(20)	CH
------	------	------	------	100	94	87	75	17	12	27	2	A-4(8)	ML
100	99	98	94	90	88	80	73	22	16	29	7	A-4(8)	ML-CL
[6] 67	------	------	65	60	58	56	50	31	28	50	18	A-7-5(8)	ML
------	------	------	------	100	98	95	80	18	11	33	4	A-4(8)	ML
------	------	------	100	99	97	93	85	30	24	30	11	A-6(8)	CL
------	------	------	100	99	97	93	87	33	26	34	10	A-4(8)	ML-CL
------	------	------	------	100	99	93	84	12	8	23	1	A-4(8)	ML
------	------	------	------	100	99	96	86	46	41	48	25	A-7-6(14)	CL
------	------	------	------	100	99	95	85	44	38	59	38	A-7-6(20)	CH
------	------	100	99	98	97	86	77	17	13	32	7	A-4(8)	ML-CL
------	------	100	97	96	95	88	82	39	36	45	20	A-7-6(13)	ML-CL
------	------	100	99	98	98	90	84	41	37	46	23	A-7-6(15)	CL
------	------	------	100	99	98	96	89	26	16	31	6	A-4(8)	ML
------	------	100	98	95	90	87	82	44	36	41	17	A-7-6(11)	ML-CL
------	100	98	95	90	85	81	76	37	31	39	18	A-6(11)	CL

[2] The Oklahoma Department of Highways classification procedure further subdivides the AASHO A-2-4 subgroup into the following: A-2-3(0) if the plasticity index equals nonplastic (NP); A-2(0) if the plasticity index equals nonplastic to 5; and A-2-4(0) if the plasticity index is 5 to 10.

[3] Based on the Unified Soil Classification System (*7*). The Soil Conservation Service and the Bureau of Public Roads have agreed that all soils having a plasticity index within 2 points of the A-line are to be given a borderline classification. Examples of borderline classifications are SM-SC and ML-CL.

[4] NP=Nonplastic.

[5] 100 percent passes 2-inch sieve.

[6] 72 percent passes 2-inch sieve, and 83 percent passes 3-inch sieve.

tent. Shrinking and swelling of soils causes much damage to building foundations, roads, and other structures.

Permeability, as used in table 4, relates only to movement of water downward through undisturbed and uncompacted soil (given in inches per hour through the least permeable layer). It does not include lateral seepage. The estimates are based on structure and porosity of the soil. Plowpans, surface crusts, and other properties resulting from use of the soils are not considered.

Corrosivity, as used in this survey, indicates the potential danger to uncoated steel or concrete structural material where it is buried in soil. Installations that intersect soil boundaries or soil horizons are more likely to be damaged by corrosion than are installations entirely in one kind of soil or soil horizon.

Engineering interpretations of the soils

Table 5 contains selected information about the soils for engineers and others who plan to construct highways, farm facilities, buildings, and sewage disposal systems. Detrimental or undesirable features are emphasized, but very important desirable features also may be listed. The ratings and other interpretations in this table are based on estimated engineering properties of the soils listed in table 4; on available test data, including those in table 6; and on field experience. Rough stony land is omitted from the

table, because its properties are too variable for interpretation. Its depth to bedrock ranges from 0 to 1 foot.

Topsoil is a fertile soil or soil material, ordinarily rich in organic matter, used as topdressing for lawns, gardens, roadbanks, and the like.

Suitable sources of sand and gravel are not rated in table 5, because none of the soils in the county are suitable sources of sand and only a few are suitable for gravel. The Clarksville and Eldorado soils are not suitable for gravel, because their chert fragments and stones are too large. Except for the Elsah, Sallisaw, and Staser soils, the rest of the soils in the county are not suitable for gravel. The Elsah, Sallisaw, and Staser soils are good for road surfacing. Gravel from streambeds is used locally for concrete.

Road fill is material used to build embankments. The ratings in table 5 indicate the performance of soil material that is moved from borrow areas for this purpose.

Highway location is influenced by features of the undisturbed soil that affect construction and maintenance of highways.

The reservoir areas of farm ponds are affected mainly by loss of water through seepage. The soil features named are those that influence seepage.

Farm pond embankments serve as dams. The soil features given for the subsoil and substratum are those that affect the choice of material that is used in embankments.

Foundations for low buildings are affected chiefly by features of the undisturbed soil that influence its capacity to support buildings. The ratings in table 5 are for soils that are to be used as foundations for buildings not more than three stories high that have normal foundation loads.

Septic tank filter fields are affected mainly by permeability, location of water table, susceptibility to flooding, depth to bedrock, and slope.

Sewage lagoons are influenced chiefly by soil permeability, location of water table, slope, and the like.

A hydrologic soil group consists of soils that have the same runoff potential under similar storm conditions and similar plant cover. Group A has the lowest runoff potential, and group D has the highest.

Test data

Table 6 contains the results of engineering tests performed by the Oklahoma Department of Highways on samples from several important soils in Cherokee and Delaware Counties. The table shows the specific location where the samples were taken, the depth to which sampling was done, and the results of tests to determine particle-size distribution and other properties of the soil.

Shrinkage of a soil is decrease in volume, in proportion to loss in moisture. As moisture is removed, shrinkage continues to a limit beyond which no further decrease in volume occurs, though additional moisture is removed. The moisture content at which shrinkage stops is called the shrinkage limit. In general, the lower the shrinkage limit, the higher the content of clay. As a rule, the capacity of soil material to carry a load is highest when the moisture content is at or below the shrinkage limit.

The shinkage ratio is the relation between the volume change of a soil and the corresponding change in water content, above the shrinkage limit. The volume change used in computing this ratio is the change that takes place in a soil when it dries from a given moisture content to the shrinkage limit. It is expressed as a percentage of the dry volume of the soil mass. The field moisture equivalent is the minimum moisture content at which a smooth soil surface will absorb no more water within 30 seconds when the water is added in individual drops. This is the moisture content required to fill all of the pores in sands and to approach saturation in cohesive soils.

Mechanical analyses show the percentages, by weight, of soil particles that would pass through sieves of specified sizes. Sand and other coarser materials are retained on the No. 200 sieve, but silt and clay pass through it. Silt is that material larger than 0.002 millimeter in diameter, and clay is that fraction passing through the No. 200 sieve that is smaller than 0.002 millimeter in diameter. The clay fraction was determined by the hydrometer method.

Liquid limit and plasticity index indicate the effect of water on the strength and consistence of soil material. As the moisture content of a clayey soil is increased, the material changes from a semisolid to a plastic state. If the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material passes from solid to plastic. The liquid limit is the moisture content at which the material changes from plastic to liquid. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is plastic.

The AASHO and Unified classifications are explained in the subsection "Engineering classification systems."

Formation and Classification of Soils

This section discusses the five major factors of soil formation as they affect the formation of soils in the two counties. It also explains the current system for classifying soils in higher categories.

Factors of Soil Formation

Soil is produced by the action of soil-forming processes on materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material; (2) the climate under which the soil material has accumulated and has existed since accumulation; (3) the plant and animal life on and in the soil; (4) the relief, or lay of the land; and (5) the length of time the forces of soil development have acted on the parent material.

Climate and vegetation are the active factors in soil formation. They act on the parent material accumulated through the weathering of rocks and slowly change it into a natural body that has genetically related horizons. The effects of climate and vegetation are conditioned by relief. The parent material also affects the nature of the profile and, in extreme instances, determines most of its characteristics. Finally, time is needed to change the parent material into a soil profile. It may be much or little, but generally much time is required to develop a profile that has distinct horizons.

The five factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made about the effect of any one unless conditions

are specified for the other four. Many of the processes of soil development are unknown.

Parent material

Parent material is weathered, unconsolidated rock or mineral material from which soils develop. In many soils it is the C horizon. In the formation of soils, parent material affects the color, texture, structure, natural fertility, and other characteristics.

The two general kinds of parent material in the survey area are residuum and alluvium. On the prairie, soils developed from residuum derived from shales, sandstones, and limestones of the Pennsylvanian age. The Dennis, Okemah, and Choteau soils developed mostly from shale and sandstone material. The Bates and Collinsville soils developed over sandstone. The Bates soils have a loamy, clay-enriched horizon, and the Collinsville soils have a loamy horizon that corresponds to the subsoil.

The Summit and Talpa soils developed in loamy or clayey material over limestone. The Parsons, Taloka, and Woodson soils developed from clayey valley fill, which is alluvium. These soils have a clay-enriched horizon that is similar to the parent material but that has been strongly weathered.

Also on the prairie, soils developed from residual material derived from the cherty limestone of the Boone formation. The Boone formation is of Mississippian age and consists of loamy and cherty limestone. The deep, reddish, loamy Newtonia soils developed over cherty limestone in valleys. The deep Eldorado soils have a loamy, cherty subsoil and are gently sloping to strongly sloping. In these two kinds of soils, a clay-enriched horizon has developed deep in the profile. The Clarksville, Baxter, Locust, Captina, and Stigler soils are residual and have cherty to silty clay-enriched horizons. The chert in these soils indicates the kind of parent material from which the soils developed.

The shallow Hector soils and deeper Linker soils were derived from the Atoka formation of the Mississippian age. This formation is sandstone. The Hector soils have a moderately coarse textured horizon that corresponds to the subsoil, and the deeper Linker soils have a medium-textured subsoil.

Loamy to clayey deposits of Quaternary age occur along the streams and rivers. Staser and Verdigris soils developed in the loamy deposits on the flood plains. Sallisaw soils developed in loamy material on benches. Osage soils are clayey and occur on flood plains. Elsah soils, which have very gravelly horizons, formed where stream overflow is frequent.

Climate

The climate of the survey area is temperate and humid. Winds are southerly. Rainfall is generally well distributed throughout the year, but dry periods that last 2 to 6 weeks occur during the summer. The average annual rainfall is about 43 inches and is enough to support trees that contribute to soil development in about 60 percent of the area. Intensive rains commonly occur during spring and cause soil loss through erosion on most slopes. Erosion has occurred on most cultivated soils in the two counties.

The average annual temperature is about 59° F., but extremes of temperature are higher than 90° and less than 0°. The frost-free season is about 200 days. Freezing and thawing have especially altered the rock structure in the upper 2 feet of soil that developed in cherty limestone material.

The climate is fairly uniform throughout the survey area and is partly responsible for the dominance of prairie grasses or trees. The influence that climate has in weathering soil material and in developing horizons is greatly altered by the effects on soil of parent material, vegetation and animals, relief, time, and man.

Plant and animal life

Plants and animals are active in soil formation. Plants and micro-organisms grow in the weathered parent material and help break down rock structure. They also produce organic residue. As this residue is produced, an organic layer (A1 horizon) is formed and gradually thickens.

The organic layer is the most fertile part of the soil. In this layer bacteria, fungi, and other micro-organisms decompose organic matter, convert humus to simpler forms, liberate plant nutrients, and fix nitrogen. Larger organisms, such as the earthworms that are plentiful in the Verdigris soils, contribute to the translocation of plant residue, to soil aeration, and to the development of soil structure.

The kind and amount of vegetation regulate the thickness of the A1 horizon. The kind of vegetation depends on the moisture supply and on the texture and acidity of the surface layer. The vegetation in the survey area is mostly hardwoods and pines with an understory of native grasses. On uplands the soils that developed under this kind of vegetation are in the Baxter, Captina, Clarksville, Hector, Linker, Locust, and Stigler series. They have a thin A1 horizon, have an A2 horizon, and are low to medium in percentage of base saturation.

The alluvial Osage, Staser, and Verdigris soils also developed under timber, but they have a thicker, dark-colored A horizon since they receive extra water for more plant growth. Timber on the frequently flooded Elsah soils has added only a small amount of organic matter because these soils are very young and have little profile development. The Sallisaw soils also developed in alluvium under timber, but they have a lower percentage of base saturation.

The other soils in the survey area formed under native grass and have a thick, dark surface layer. Since about one-third of the grass plant roots die and are regrown each year, large amounts of plant residue and basic elements are returned to the surface layer. These soils of the prairie normally are less acid than soils formed under timber on the uplands.

Relief

Relief, or lay of the land, influences soil development and horizon formation. If the slope is steep, runoff removes soil material almost as fast as it forms. If the slope is nearly level, however, soil material accumulates.

In the timbered areas of cherty limestone, relief has an effect on profile development of the Clarksville, Baxter, Locust, Captina, and Stigler soils. These leached soils formed under timber and have a low percentage of base saturation in the upper horizons. The Clarksville soils are the steepest soils of this group. They are the most excessively drained. The Stigler soils are the most nearly level and the most poorly drained. Since runoff is greatest on the Clarksville soils, they are more cherty in the upper horizons than the other soils and have gray mottles at

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greater depths. The Clarksville soils also have a more reddish subsoil than any of the other soils except the Baxter.

The gently sloping Baxter soils are adjacent to the Clarksville soils in many places. In these places Baxter soils show the effect of good drainage by having a reddish, clay-enriched horizon that is more clayey than that in the Clarksville soils. Locust and Captina soils have slopes similar to those of the Baxter soils but are more poorly drained and have a more brownish and less clayey subsoil. The somewhat poorly drained, nearly level Stigler soils have gray mottles in the upper part of the clay-enriched horizon and are more alkaline in the lower part than the other soils.

The relief of the soils on the prairie ranges from nearly level to strongly sloping. The nearly level Parsons and Taloka soils receive additional water and have more water percolating through the profile to influence loss, gain, and transfer of soil constituents. They have lost clay, iron, alluvium, and base elements from a bleached eluvial horizon. The eluvial horizon and the upper clay-enriched horizon are usually more acid and have a lower base saturation than those in most of the other soils on the prairie. The very gently sloping Jay soils are associated with the Parsons and Taloka soils. The base saturation of the Jay soils is similar to that of the Parsons and Taloka soils, but Jay soils contain a fragipan.

The nearly level to strongly sloping Choteau, Dennis, Eldorado, Newtonia, and Okemah soils have soft upper horizons and thickly developed clay-enriched horizons. These horizons have a reddish color or have coarse reddish mottles, except for the slightly wetter Okemah soils. Mottles in the Okemah soils are grayish.

The very gently sloping Bates and gently sloping Collinsville soils developed over sandstone. The moderately deep Bates soils do not have such a thickly developed clay-enriched horizon as do some soils of the prairie. Since Collinsville soils have more runoff than the Bates soils, they are not so deep over sandstone. They do, however, have a fine sandy loam subsoil.

The gently sloping Summit soils and gently sloping to steep Talpa soils formed over limestone. The deep, clayey Summit soils have a clay-enriched horizon that cracks on drying. The shallow Talpa soils are usually steeper than the Summit soils and have slightly developed clay loam subsoil horizons.

The Woodson soils are nearly level and generally receive additional water. These wet soils have grayish clay-enriched horizons containing concretions of manganese and calcium carbonate.

The Elsah, Sallisaw, Staser, and Verdigris soils developed in alluvium along timbered streams. Except for the Sallisaw soils, these soils receive flood water that contributes to the thickening of the A horizon and to the high percentage of base saturation. The Sallisaw soils are older than the others. They are nearly level to sloping and occur on benches. Sallisaw soils have a thick clay-enriched horizon but lack the soft horizon and the base saturation of the other soils.

Time

The length of time required for a soil to develop depends on the combined effects of the other soil-forming factors. The soils in the survey area range from immature to old. The age of soils is indicated by their degree of development.

Elsah soils are immature and alluvial. They have little profile development except for some addition of organic matter. The Osage, Staser, and Verdigris soils have a thicker A horizon than the Elsah soils but lack the thick, clay-enriched horizon of the alluvial Sallisaw soils.

The youthful Collinsville, Hector, and Talpa soils developed over sandstone or limestone on upland slopes where runoff is considerable. They have little clay accumulation in the subsurface horizon, but the Collinsville and Talpa soils do have a thick, dark-colored A horizon.

Old soils derived from cherty limestone in timbered areas are in the Baxter, Captina, Clarksville, Locust, and Stigler series. They have a thin, light-colored A horizon over a strongly acid A2 horizon that is mostly leached of bases. The Clarksville and Baxter soils have considerable chert in the upper horizons, but their B2t horizon is deeply weathered. Fragipans have developed in the Locust and Captina soils. The Locust soils contain some chert, but most of the chert has been weathered in the upper horizons of the Captina soils. The nearly level Stigler soils have little weatherable chert in the upper horizons, and they have a clay-enriched horizon that has a higher percentage of base saturation than associated soils.

Mature soils developed in prairie areas are in the Choteau, Dennis, Eldorado, Newtonia, and Okemah series. These soils have a thick, dark-colored surface layer, a high percentage of base saturation, and a deeply developed clay-enriched B2t horizon. The Bates soils are slightly younger since their clay-enriched horizon is not deeply developed.

The more clayey Summit and Woodson soils have a clay-enriched horizon that is influenced by parent material and wetness.

Old soils in prairie areas include the Parsons and Taloka. These nearly level soils have a surface layer underlain by a bleached eluvial horizon that is leached of clay, iron and alluvium, and base elements. This horizon rests abruptly on a clay-enriched horizon.

Classification of Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationships to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to manipulations. First through classification and then through the use of soil maps, we can apply our knowledge of soils to specific fields or other tracts of land.

Thus, in classification, soils are placed in narrow categories that are used in detailed soil surveys so that knowledge about the soils can be organized and applied in managing farms, fields, and woodlands; in developing rural areas; in engineering work; and in many other ways. The soils are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

The current system of classification was adopted for general use by the National Cooperative Soil Survey in 1965. Since the current system is under continual study, readers interested in its development should search the latest literature available (*6*, *3*). In table 7, the soil series represented in Cherokee and Delaware Counties are placed

TABLE 7.—*Soil series classified according to the current system of classification*

Series	Family	Subgroup	Order
Bates	Fine-loamy, siliceous, thermic	Typic Argiudolls	Mollisols.
Baxter	Clayey, mixed, mesic	Typic Paleudults	Ultisols.
Captina	Fine-silty, mixed, mesic	Typic Fragiudults	Ultisols.
Choteau [1]	Fine-silty, mixed, thermic	Typic Paleudolls	Mollisols.
Clarksville	Loamy-skeletal, siliceous, mesic	Typic Paleudults	Ultisols.
Collinsville	Loamy, siliceous, thermic	Lithic Hapludolls	Mollisols.
Dennis [1]	Fine, mixed, thermic	Typic Paleudolls	Mollisols.
Eldorado	Loamy-skeletal, mixed, thermic	Typic Paleudolls	Mollisols.
Elsah	Loamy-skeletal, mixed, nonacid, mesic	Dystric Fluventic Eutrochrepts	Inceptisols.
Hector	Loamy, siliceous, thermic	Lithic Dystrochrepts	Inceptisols.
Jay	Fine-silty, mixed, thermic	Mollic Fragiudalfs	Alfisols.
Linker	Fine-loamy, siliceous, thermic	Typic Hapludults	Ultisols.
Locust	Fine-loamy, mixed, thermic	Typic Fragiudults	Ultisols.
Newtonia	Fine-silty, mixed, thermic	Typic Paleudolls	Mollisols.
Okemah	Fine, mixed, thermic	Aquic Paleudolls	Mollisols.
Osage	Fine, montmorillonitic, noncalcareous, thermic	Vertic Haplaquolls	Mollisols.
Parsons	Fine, mixed, thermic	Mollic Albaqualfs	Alfisols.
Sallisaw	Fine-loamy, mixed, thermic	Ultic Paleudalfs	Alfisols.
Staser [1]	Fine-loamy, mixed, thermic	Fluventic Hapludolls	Mollisols.
Stigler	Fine, mixed, thermic	Aquultic Paleudalfs	Alfisols.
Summit	Fine, montmorillonitic, thermic	Vertic Argiudolls	Mollisols.
Taloka	Fine, mixed, thermic	Mollic Albaqualfs	Alfisols.
Talpa	Loamy, mixed, thermic	Lithic Haplustolls	Mollisols.
Verdigris	Fine-silty, mixed, thermic	Cumulic Hapludolls	Mollisols.
Woodson	Fine, mixed, noncalcareous, thermic	Abruptic Argiaquolls	Mollisols.

[1] The classification of the Choteau, Dennis, and Staser series has been changed since the soil survey was correlated in 1967.

in some of the higher categories of the current system. The classes of the current system are briefly defined in the following paragraphs:

ORDER: Ten soil orders are recognized. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The orders tend to give broad climatic groupings of soils. Two exceptions, Entisols and Histosols, occur in many different climates.

Table 7 shows that the four soil orders recognized in Cherokee and Delaware Counties are Inceptisols, Mollisols, Alfisols, and Ultisols.

Inceptisols, is a word coined from the Latin word *inceptum*, meaning the beginning. They are young soils and show weak eluviation or illuviation. The shallow Hector soils and the deep Elsah soils have weakly expressed horizons and Inceptisols are typical of the area.

Mollisols is a term derived from the Latin word *mollis*, meaning soft. These soils have a thick, friable, surface layer that is easily worked. Mollisols are dark-colored and have a good organic-matter content.

Alfisols is a word taken from the *alf* in Pedalfer, a general term applied to an extensive area of the eastern United States. The Alfisols are commonly characterized by eluvial A2 horizons and illuvial B horizons. These soils do not have the dark, thick surface layer that is rich in organic matter and that is characteristic of Mollisols.

In Ultisols the *ult* is from *ultimus*, meaning last. These strongly weathered soils commonly occur in timbered areas in the eastern part of Oklahoma. They are strongly to very strongly acid and commonly have an eluvial A horizon and an illuvial B horizon. Ultisols lack both the dark, thick surface layer of the Mollisols and the high percentage of base saturation of the Alfisols.

SUBORDERS: Each order is subdivided into suborders, primarily on the basis of those characteristics that seem to produce classes with the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders mainly reflect either the presence or absence of waterlogging, or differences resulting from climate or vegetation. Suborders are not shown in table 7.

GREAT GROUP: Suborders are separated into great groups on the basis of uniformity in the kinds and sequences of major soil horizons and features of those horizons. The horizons used to make separations are those in which clay, iron, or humus have accumulated or those that have pans interfering with growth of roots and movement of water. The features used are self-mulching properties of clay, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), and the like. The great group is not shown in table 7, because it is the last word in the name of each subgroup.

SUBGROUP: Great groups are subdivided into subgroups, one that represents the central (typic) segment of the group and others, called intergrades, that have properties of one group and also one or more properties of another great soil group, suborder, or order. The names of the subgroup are derived by placing one or more adjectives before the name of the great group. An example is a Typic Hapludoll.

FAMILY: Families are separated within a subgroup primarily on the basis of properties that are important to the growth of plants or behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence.

General Facts About the Counties[9]

Additional information about the soil survey area is given in this section. It will be most useful to persons not familiar with Cherokee and Delaware Counties. It tells about climate, relief and drainage, settlement and development, natural resources, transportation and industry, and agriculture.

Climate

Cherokee and Delaware Counties share a mild, temperate climate, for they occupy a major part of the Ozark Highland in the northeastern part of Oklahoma (*4*). This is an area of wooded hills, small prairies, pasturelands, many streams, and four large lakes. Elevations above sea level range from 600 to 1,500 feet. Rainfall is ample for farming in the area, and it encourages natural beauty and tourism. The major changes in the weather and the heaviest rains occur when the warm moisture-laden air from the Gulf of Mexico meets the cool, drier air from the Pacific Ocean and Arctic areas.

Because of these continental effects, there are pronounced daily and seasonal changes in temperature and variations in seasonal and annual rainfall. Seasonal changes are gradual, but each season is distinct. Winters are mild and short. They have brief cold periods and occasional snows; January is the driest month. In spring and early in summer the severe local storms and the heaviest rains are most numerous. Summers are long and hot, the heat is moderated by occasional showers or thunderstorms and moderate winds. A secondary period of heavy precipitation occurs early in fall and is followed by many pleasant, sunny days and cool nights.

Table 8 is a summary of temperature and precipitation at Tahlequah, in Cherokee County. Other significant factors of climate are discussed in the following paragraphs.

Mean annual temperature ranges from 59° to 61°F. in the area, and the monthly average temperature ranges from 38° in January to 82° in July. A mean daily temperature range of 24° helps to ease the hot weather. The greatest range of extreme temperatures occurred at Tahlequah and was from 23° on January 18, 1930, to 118° on both July 18 and August 8, 1936. Freezing temperatures occur on an average of 85 days from October through April, but the daily temperature fails to rise above freezing on only 5 of these days. Temperatures of zero or below occur in 1 year out of 3, but in 1940 there were 4 days that had a temperature of zero or below. In 1941, the warmest winter recorded, the temperature did not fall below 14°.

Tahlequah has an annual total of 3,552 degree-days. Degree-days range from none from June through August to a maximum of 818 in January. In 11 out of 15 years, warm weather of 90° or above has occurred from March into November on an average of 71 days per year, and of 100° or above on 15 days per year. Temperatures of 110° or above occurred in 2 out of 15 years.

Annual rainfall averages nearly 41 inches in the western part of Cherokee County and increases eastward to 45 inches in the southeastern part of Delaware County. Driest years have ranged from 18.84 inches of precipitation at Fort Gibson Dam to 28.71 inches at Grove. The wettest years have ranged from 58.09 inches at Fort Gibson Dam

[9] Prepared with the assistance of BILLY D. DUDLEY, work unit conservationist, and ROGER M. CATE, soil conservation technician, Soil Conservation Service.

TABLE 8.—*Temperature and precipitation*

[All Data from Tahlequah, Cherokee County, Oklahoma; period of Record 1931–60]

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	Two years in 10 will have at least 4 days with— Maximum temperature equal to or higher than—	Two years in 10 will have at least 4 days with— Minimum temperature equal to or lower than—	Average monthly total	One year in 10 will have— Less than	One year in 10 will have— More than	Days with snow cover 1 inch or more	Average depth of snow on days with snow cover
	°F.	*°F.*	*°F.*	*°F.*	*Inches*	*Inches*	*Inches*	*Number*	*Inches*
January	49.8	27.4	68	10	2.33	0.1	5.4	2	3
February	54.6	30.8	70	15	2.79	.6	7.1	1	2
March	62.2	37.3	78	20	3.17	1.0	6.8	([1])	4
April	72.5	48.5	84	33	4.63	2.2	9.7	([1])	2
May	79.4	55.9	88	42	6.14	2.2	12.1		
June	87.7	65.3	100	54	5.10	1.0	10.1		
July	93.2	68.8	103	61	3.00	.2	8.9		
August	93.6	67.7	105	57	3.05	.2	6.0		
September	86.7	59.7	99	45	4.00	.6	7.5		
October	75.6	48.6	89	34	3.67	.5	7.5		
November	61.6	35.8	77	19	2.89	.5	5.5	([1])	2
December	52.7	30.0	69	16	2.33	.5	5.0	([1])	3
Year	72.4	48.0	[2]105	[3]3	43.10	28.0	54.9	3	3

[1] Less than 0.5 day.
[2] Average annual maximum.
[3] Average annual minimum.

to 65.40 inches at Tahlequah. The seasonal distribution of precipitation is 34 percent in spring, 28 percent in summer, 22 percent in fall, and 16 percent in winter. The greatest monthly rainfall has ranged from 7.70 inches at Fort Gibson Dam in December 1951 to 18.26 inches at Grove in May 1943. Heavy daily rains of 3 to 5 inches are most common in May, June, and October and occur about twice every 3 years. Daily totals of 0.1 inch or more occur on an average of 61 days per year; totals of 0.5 or more occur on 27 days; and totals of 1.0 inch or more occur on 15 days.

Seasonal snowfall averages between 5 and 7 inches and is 6.0 inches at Tahlequah. Only one winter out of 16 has received more than 15 inches of snow; the greatest amount was 23.3 inches in 1963–64. Monthly totals of more than 10 inches have occurred only five times in 65 years. The greatest monthly snowfall was 19.5 inches in January 1895. A snow cover of 4 to 5 inches occurs in about 1 year out of 5 and remains only a few days. The greatest depth was 11 inches on January 22, 1937, and this snow required 7 days to melt.

Average dates of freezing temperature may vary a few days from those given in table 9, depending on the vegetation, adjacent bodies of water, and slopes that accelerate the surface drainage of cold air. The dates of the latest freeze of 32° in spring ranged from March 10 to May 12, and the dates of the earliest freeze in fall ranged from September 27 to November 21. The freeze-free season averages from 185 days in the eastern part of Delaware to 212 days in the western part of Cherokee County.

Records from Fort Smith and other stations nearby provide data on relative humidity, cloudiness, sunshine, wind, and evaporation that can be interpolated to provide data for the survey area. Relative humidity in winter averages nearly 80 percent at night and 60 percent in the afternoon. For summer the average is nearly 85 percent at night and 55 percent in the afternoon. An average year has 130 clear days, 95 partly cloudy days, and 140 cloudy days. The percent of possible sunshine ranges from an average of 48 percent in January to 73 percent in August; the annual average is 62 percent. Hourly windspeed averages 10 miles per hour for the year and ranges from 12 miles per hour in March to 8 miles per hour in July and August. Northerly winds prevail in January and February, but in all other months southeasterly winds are dominant. Annual lake evaporation averages about 48 inches, and 72 percent of this amount occurs from May to October.

Records kept on storms for 92 years show that only 19 tornadoes have hit these two counties. Two of these accounted for 60 deaths at Peggs on May 2, 1920, and 4 deaths at Hulbert on April 12, 1945. Five of these tornadoes injured 108 people. Three-fourths of the tornadoes have moved eastward or northeastward and all have occurred in the two-county area in the past 43 years. Most hailstorms have occurred in April and May and have had stones varying from ¾ inch to 1½ inches in size. They moderately damaged roofs and crops. The greatest loss from hail occurred at Tahlequah on June 6, 1924, and at Grove on May 8, 1961. At Grove stones of 1 inch to 3 inches in size caused $125,000 damage to homes, schools, and crops.

Relief and Drainage

Cherokee and Delaware Counties are mostly hilly, but there are smaller areas that are more gently sloping. The general slope is from the northeast to the southwest. The Grand and Illinois Rivers drain most of the two counties. The Elk River and Honey, Spavinaw, Salina, and Fourteen Mile Creeks are the main streams draining into the Grand River. Flint, Barren Fork, and Caney Creeks drain into the Illinois River. These rivers and creeks have entrenched about 200 to 400 feet and have imparted a hilly relief to most of the area.

Landforms in the two counties include prairies and cherty limestone and sandstone areas. In Delaware County the prairie areas occur northwest of Grand River, just south of Elk River, near Maysville, Arkansas, and are interspersed throughout Cherokee County. These prairies are mostly nearly level to sloping. The cherty limestone and sandstone areas are hilly. The divides between drainageways are nearly level to sloping and ¼ to 4 miles wide, but the slopes that extend into the drains are strong to very steep. The larger areas that are drained consist of nearly level to very gently sloping flood plains and nearly level to sloping benches. The drainageways range from 200 feet wide along the smallest streams to about 2 miles wide along some of the rivers.

TABLE 9.—*Probabilities of last freezing temperatures in spring and first in fall*

[All data from Tahlequah, Cherokee County; Period of record 1923–50]

Probability	Dates for given probability and temperature				
	16° F.	20° F.	24° F.	28° F.	32° F.
Spring:					
1 year in 10 later than	March 6	March 25	April 5	April 11	April 27
2 years in 10 later than	February 26	March 17	March 29	April 6	April 21
5 years in 10 later than	February 11	March 3	March 17	March 28	April 9
Fall:					
1 year in 10 earlier than	November 22	November 16	October 27	October 19	October 9
2 years in 10 earlier than	November 29	November 21	November 2	October 24	October 14
5 years in 10 earlier than	December 13	December 2	November 14	November 3	October 25

Settlement and Development

The early settlement of Cherokee and Delaware Counties was by the Cherokee, Delaware, and Seneca Indians. When Oklahoma became a State, the counties were named after the Cherokee and Delaware Indians. Land was allotted to the Indians on basis of its cash value, the largest allotments in size being in the hilly timbered areas. Land also could be leased for farming subject to the supervision of the Indian Agency. The sale or lease of land brought white settlers into the area.

Most of the early settlers farmed. In the hilly, timbered areas, the land had to be cleared before it could be cultivated. Some settlers quit farming and sold out because they found that the areas they had bought were not suitable for cultivation. Farmers in other areas acquired these areas, and farm units increased in size.

Five large reservoirs were built on streams in the survey area for municipal and industrial purposes. Some industry was established.

Tahlequah, the old Cherokee Capital, is the county seat of Cherokee County. Hulbert, which is smaller, is the only other sizable town in the county. Jay is the county seat of Delaware County, and other sizable towns in the county are Grove, Colcord, and Kansas.

Natural Resources

The natural resources of the survey area are mainly water, timber, gravel, limestone, wild game and fish, and scenic beauty.

The water supply for towns comes mainly from wells, perennial streams, and reservoirs. Hydroelectric and flood control reservoirs furnish cheap electricity and irrigation water. Wells, springs, and farm ponds supply water for livestock needs. The water in the lakes and streams is crystal clear and of high quality. Tulsa, Okla., and many small towns have spent millions of dollars on reservoirs and pumping facilities in the two counties.

The income from timber is less than it was in past years. Most of the timber has been cut over, and the trees that were left to propagate the stands are of poor quality. This timber is now used mainly for the production of tool handles, gunstocks, and special furniture parts.

In the survey area deposits of gravel along streams are abundant but the gravel is little used except as road material and in cement mixtures. The gravel is used for roads mainly on gently sloping soils since most of the soils in hilly areas contains chert, sandstone, or shale material.

Limestone is the most common mineral in the area and some of it is mined for commerial and agricultural purposes. Sample specimens of lead and zinc also occur.

Clear running streams and the lakes in the hilly, timbered areas provide scenic beauty that attracts thousands of visitors each year. Visitors are most numerous when the redbud and dogwood trees bloom in the spring and the hardwood trees turn from green to brilliant colors in the fall.

Wildlife and fish are abundant in the survey area. Big game has been restocked on game reserves in the Cookson and Spavinaw hills. During short periods these reserves are open for deer hunting. Quail, dove, and duck are hunted during season in all areas. These and other kinds of game are stocked by commercial and private game farms. Fishing is a year-round sport on the streams and lakes, for commercial docks are heated during winter.

Transportation and Industry

Although there are no railroads within the survey area, bus service and freight trucking are available in Tahlequah, Jay, and other communities. Federal and State highways form a network of paved roads in the two counties. U.S. Highway No. 59 extends north to south across Delaware County and U.S. Highway No. 60 crosses the northwest corner. State Routes 10 and 82 extend north and south across the survey area, and State Routes 25, 20, 33, and 51 are the main east and west roads.

In farm areas graded chert, sandstone, gravel, shale, and dirt roads provide access to the hard-surfaced roads in nearly all weather. Some areas in the most hilly part, however, have few roads.

Grain elevators are located in adjoining counties, and most dairy farmers market their milk in nearby large cities.

Livestock is marketed in the survey area at sale rings near Jay and Tahlequah. Poultry and poultry products are sold to the egg-processing plant at Grove, to the broiler-processing plant at Jay, and to markets outside of the survey area.

Sawmills are scattered throughout the survey area. Timber is used by the gunstock factory near Disney, the handle factory near Topsy, and the chair factory near Tahlequah. Two nurseries near Tahlequah sell plants. Vegetables are processed at the cannery at Kansas. Rugs and blankets are woven near Tahlequah.

Upland game is raised on a game farm near Cleora for hunting and for sale of live or dressed game. Minnows are raised in several areas near the lakes and sold for fish bait.

Agriculture

In Cherokee and Delaware Counties, the first settlers, who were Indians, found forests of pine and oak and numerous grassy savannahs and open prairie flats. Peaches and tobacco were among the first crops grown on the relatively few acres of cultivated land, but wheat and corn were the principal crops. By the mid-1930's, strawberries, tomatoes, blackberries, and green beans were important crops. Since early in the 1940's, cultivated crops have declined steadily in the survey area, as the pasture acreage and livestock enterprises have increased.

For many years the trend has been for the number of farms to decrease and the average-sized farm to increase. In Cherokee County the number of farms decreased from 1,798 in 1954 to 1,445 in 1964, while the average-sized farm increased from 128.7 to 183.1 acres. This trend was greater for Delaware County, where the number of farms dropped from 1,974 in 1954 to 1,422 to 1964 and the average-sized farm increased from 137.5 to 184.9 acres. For the same period, the total land in farms for both counties increased from 502,806 to 922,158 acres. This increase indicates that much formerly unproductive land has been put into use.

The percentage of farms operated by tenants has decreased from about 12 percent in 1954 to about 6 percent in 1964.

The number of cattle and calves has increased greatly since pastures were improved; livestock and livestock products made up about 64 percent of the total value of all farm products sold in 1964. In 1964 nursery and greenhouse products reported sales of 50 percent more than those in 1959. Most other agriculture products showed similar trends.

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Glossary

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates such as crumbs, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is low from this cause.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available moisture capacity. The capacity of a soil to hold water in a form available to plants. Amount of moisture held in soil between field capacity, or about one-third atmosphere of tension, and the wilting coefficient, or about 15 atmospheres of tension.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Claypan. A compact, slowly permeable soil horizon that contains more clay than the horizon above and below it. A claypan is commonly hard when dry and plastic or stiff when wet.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefigure.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Diversion, or diversion terrace. A ridge of earth, generally a terrace, that is built to divert runoff from its natural course and, thus, to protect areas downslope from the effects of such runoff.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Genesis, soil. The manner in which a soil originates. Refers especially to the processes initiated by climate and organisms that are responsible for the development of the solum, or true soil, from the unconsolidated parent material, as conditioned by relief and age of landform.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to relatively level plots surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops, or in orchards, to confine the flow of water to one direction.

Furrow.—Water is applied in small ditches made by cultivation implements used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Irrigation water, released at high points, flows onto the field without controlled distribution.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical mineralogical, and biological properties of the various horizons, and their thickness and arrangement in the soil profile.

Mottled. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few, common,* and *many;* size—*fine, medium, and coarse; and contrast—faint, distinct, and prominent.* The size measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

Natural soil drainage. Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

Imperfectly or somewhat poorly drained soils are wet for significant periods but not all the time, and in podzolic soils commonly have mottlings below 6 to 16 inches, in the lower A horizon and in the B and C horizons.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Permeability. The quality of a soil horizon that enables water or air to move through it. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

pH value. A numerical means for designating relatively weak acidity and alkalinity in soils. A pH value of 7.0 indicates precise neutrality; a higher value alkalinity; and a lower value, acidity.

Plowpan. A compacted layer formed in the soil immediately below the plowed layer.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressd thus:

	pH		*pH*
Extremely acid	Below 4.5	Mildly alkaline	7.4 to 7.8
Very strongly acid	4.5 to 5.0	Moderately alkaline	7.9 to 8.4
Strongly acid	5.1 to 5.5	Strongly alkaline	8.5 to 9.0
Medium acid	5.6 to 6.0	Very strongly alkaline	9.1 and higher
Slightly acid	6.1 to 6.5		
Neutral	6.6 to 7.3		

Residual material. Unconsolidated, partly weathered mineral material that accumulates over disintegrating solid rock. Residual material is not soil but is frequently the material in which a soil has formed.

Sand. Individual rock or mineral fragments in soils having diameters ranging from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles, less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: *Very coarse sand* (2.0 to 1.0 millimeter); *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.05 to 0.002 millimeter); and *clay* (less than 0.002 millimeter). The separates recognized by the International Society of Soil Science are as follows: I (2.0 to 0.2 millimeter); II (0.2 to 0.02 millimeter); III (0.02 to 0.002 millimeter); IV, less than 0.002 millimeter).

Slope. Soil slope is expressed in words and percentage of gradient. In these counties slopes are as follows: Nearly level, 0 to 1 percent; very gently sloping, 1 to 3 percent; gently sloping, 3 to 5 percent; sloping, 5 to 8 percent; strongly sloping, 8 to 12 percent; moderately steep, 12 to 20 percent; steep, 20 to 50 percent; and very steep, 50+ percent.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surplus runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

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SOIL ASSOCIATIONS

1	Sallisaw-Elsah-Staser association: Deep, gravelly or loamy, nearly level to sloping soils on flood plains and benches
2	Eldorado-Newtonia-Okemah association: Deep, loamy, nearly level to strongly sloping soils on prairie uplands
3	Clarksville-Baxter-Locust association: Deep, stony and cherty, very gently sloping to steep soils on timbered uplands
4	Baxter-Locust association: Deep, cherty and loamy, nearly level to gently sloping soils on timbered uplands
5	Hector-Linker association: Very shallow to deep, stony and loamy, gently sloping to steep soils on uplands
6	Parsons-Dennis association: Deep, loamy, nearly level to very gently sloping soils that have a clayey or loamy subsoil; on prairie uplands

November 1969

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
OKLAHOMA AGRICULTURAL EXPERIMENT STATION

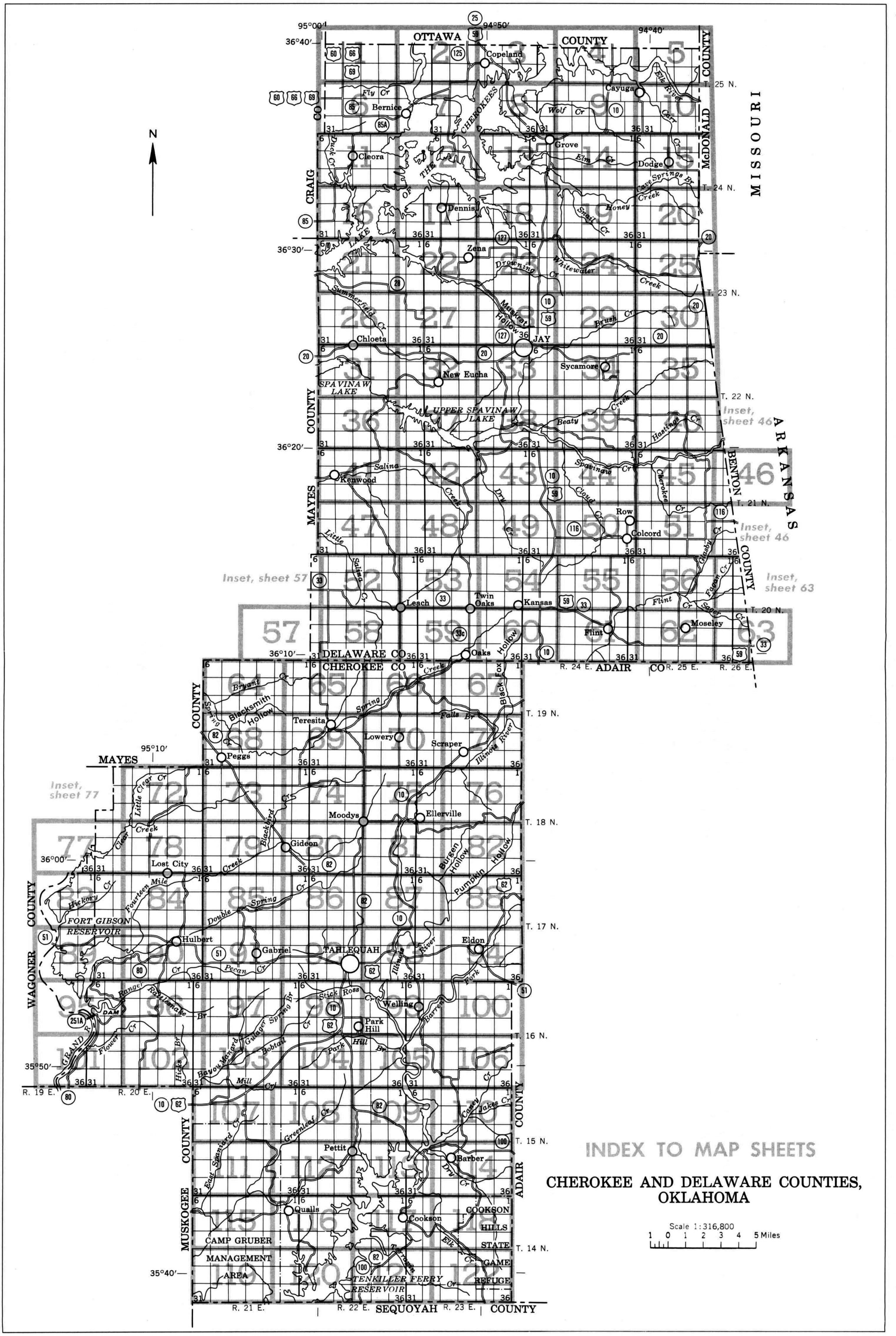
GENERAL SOIL MAP

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA

Scale 1:126,720

1 0 1 2 3 4 Miles

NOTE—
This map is intended for general planning. Each delineation may contain soils having ratings different from those shown on the map. Use detailed soil maps for operational planning.



INDEX TO MAP SHEETS

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA

Scale 1:316,800

1 0 1 2 3 4 5 Miles

SOIL LEGEND

The first capital letter is the initial one of the soil name. The second capital letter, A, B, C, D, E, or F, shows slope. Most symbols without a slope letter are those of nearly level soils, but some are for land types that have a considerable range of slope. The final number, 2, in a symbol shows that the soil is eroded.

SYMBOL	NAME
BaB	Bates loam, 1 to 3 percent slopes
BcB	Baxter silt loam, 1 to 3 percent slopes
BhB	Baxter cherty silt loam, 1 to 3 percent slopes
BlC	Baxter-Locust complex, 3 to 5 percent slopes
CaB	Captina silt loam, 1 to 3 percent slopes
ChA	Choteau silt loam, 0 to 1 percent slopes
ChB	Choteau silt loam, 1 to 3 percent slopes
CkD	Clarksville very cherty silt loam, 1 to 8 percent slopes
ClE	Clarksville stony silt loam, 5 to 20 percent slopes
ClF	Clarksville stony silt loam, 20 to 50 percent slopes
CoC	Collinsville fine sandy loam, 2 to 5 percent slopes
DnB	Dennis silt loam, 1 to 3 percent slopes
EdB	Eldorado silt loam, 1 to 3 percent slopes
EdC	Eldorado silt loam, 3 to 5 percent slopes
ElD	Eldorado soils, 3 to 12 percent slopes
Es	Elsah soils
HcC	Hector fine sandy loam, 2 to 5 percent slopes
HlE	Hector-Linker association, hilly
JaA	Jay silt loam, 0 to 2 percent slopes
LkC	Linker fine sandy loam, 2 to 5 percent slopes
LoB	Locust cherty silt loam, 1 to 3 percent slopes
NaA	Newtonia silt loam, 0 to 1 percent slopes
NaB	Newtonia silt loam, 1 to 3 percent slopes
NaC	Newtonia silt loam, 3 to 5 percent slopes
NaC2	Newtonia silt loam, 2 to 5 percent slopes, eroded
OeA	Okemah silt loam, 0 to 1 percent slopes
OkA	Okemah silty clay loam, 0 to 1 percent slopes
OkB	Okemah silty clay loam, 1 to 3 percent slopes
OkC	Okemah silty clay loam, 3 to 5 percent slopes
Os	Osage clay
PaA	Parsons silt loam, 0 to 1 percent slopes
Rs	Rough stony land
SaA	Sallisaw silt loam, 0 to 1 percent slopes
SaB	Sallisaw silt loam, 1 to 3 percent slopes
SgB	Sallisaw gravelly silt loam, 1 to 3 percent slopes
SgD	Sallisaw gravelly silt loam, 3 to 8 percent slopes
Sm	Staser silt loam
Sn	Staser gravelly loam
SrA	Stigler silt loam, 0 to 1 percent slopes
SuC2	Summit silty clay loam, 2 to 5 percent slopes, eroded
TkA	Taloka silt loam, 0 to 1 percent slopes
TrD	Talpa-Rock outcrop complex, 2 to 8 percent slopes
TrF	Talpa-Rock outcrop complex, 15 to 50 percent slopes
Vd	Verdigris silt loam
Vr	Verdigris soils, frequently flooded
WoA	Woodson silt loam, 0 to 1 percent slopes

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Dual
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State or county

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail
- Railroad
- Ferry
- Ford
- Grade
- R. R. over
- R. R. under

Tunnel

Buildings
- School
- Church

Mine and quarry

Gravel pit

Power line

Pipeline

Cemetery

Dams

Levee

Tanks

Well, oil or gas

Forest fire or lookout station

Windmill

BOUNDARIES

National or state

County

Reservation

Land grant

Small park, cemetery, airport

Land survey division corners

DRAINAGE

Streams, double-line
- Perennial
- Intermittent

Streams, single-line
- Perennial
- Intermittent
  - Crossable with tillage implements
  - Not crossable with tillage implements
  - Unclassified

Canals and ditches

Lakes and ponds
- Perennial
- Intermittent

Spring

Marsh or swamp

Wet spot

Alluvial fan

Drainage end

RELIEF

Escarpments
- Bedrock
- Other

Prominent peak

Depressions (Large / Small)
- Crossable with tillage implements
- Not crossable with tillage implements
- Contains water most of the time

SOIL SURVEY DATA

Soil boundary and symbol

Gravel

Stoniness
- Stony
- Very stony

Rock outcrops

Chert fragments

Clay spot

Sand spot

Gumbo or scabby spot

Made land

Severely eroded spot

Blowout, wind erosion

Gully

Soil map constructed 1969 by Cartographic Division, Soil Conservation Service, USDA, from 1964 aerial photographs. Controlled mosaic based on Oklahoma plane coordinate system, north zone, Lambert conformal conic projection, 1927 North American datum.

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and the soil series to which the mapping unit belongs. In referring to a capability unit, range site, or woodland suitability group, read the introduction to the section it is in for general information about its management. Other information is given in tables as follows:

Acreage and extent, table 1, p. 7.
Predicted yields, table 2, p. 41.
Limitations of soils for recreation, table 3, p. 53.

Engineering uses of soils, tables 4, 5, and 6, pp. 56 through 65.

Map symbol	Mapping unit [1]	Page	Capability unit		Range site		Woodland suitability group	
			Symbol	Page	Name	Page	Number	Page
BaB	Bates loam, 1 to 3 percent slopes	8	IIe-1	35	Loamy Prairie	45	--	--
BhB	Baxter cherty silt loam, 1 to 3 percent slopes	9	IIIs-1	38	Smooth Chert Savannah	47	3	50
BlC	Baxter-Locust complex, 3 to 5 percent slopes	9	IVs-1	38	Smooth Chert Savannah	47	3	50
BcB	Baxter silt loam, 1 to 3 percent slopes	9	IIe-2	36	Smooth Chert Savannah	47	2	50
CaB	Captina silt loam, 1 to 3 percent slopes	10	IIe-2	36	Smooth Chert Savannah	47	2	50
ChA	Choteau silt loam, 0 to 1 percent slopes	11	I-2	35	Loamy Prairie	45	--	--
ChB	Choteau silt loam, 1 to 3 percent slopes	11	IIe-1	35	Loamy Prairie	45	--	--
ClE	Clarksville stony silt loam, 5 to 20 percent slopes	13	VIs-1	39	Smooth Chert Savannah	47	4	51
ClF	Clarksville stony silt loam, 20 to 50 percent slopes	13	VIIs-1	39	Steep Chert Savannah	47	6	52
CkD	Clarksville very cherty silt loam, 1 to 8 percent slopes	13	IVs-1	38	Smooth Chert Savannah	47	4	51
CoC	Collinsville fine sandy loam, 2 to 5 percent slopes	14	VIe-2	39	Shallow Prairie	46	--	--
DnB	Dennis silt loam, 1 to 3 percent slopes	15	IIe-1	35	Loamy Prairie	45	--	--
EdB	Eldorado silt loam, 1 to 3 percent slopes	15	IIe-1	35	Loamy Prairie	45	--	--
EdC	Eldorado silt loam, 3 to 5 percent slopes	16	IIIe-1	37	Loamy Prairie	45	--	--
ElD	Eldorado soils, 3 to 12 percent slopes	16	VIs-2	39	Loamy Prairie	45	--	--
Es	Elsah soils	17	Vw-1	38	-------------	--	1	49
HcC	Hector fine sandy loam, 2 to 5 percent slopes	17	VIe-1	39	Shallow Savannah	46	3	50
HlE	Hector-Linker association, hilly	17						
	Hector soil	--	VIIs-5	40	Shallow Savannah	46	6	52
	Linker soil	--	VIIs-5	40	Sandy Savannah	45	6	52
JaA	Jay silt loam, 0 to 2 percent slopes	19	IIe-2	36	Loamy Prairie	45	--	--
LkC	Linker fine sandy loam, 2 to 5 percent slopes	19	IIIe-2	37	Sandy Savannah	45	2	50
LoB	Locust cherty silt loam, 1 to 3 percent slopes	20	IIIs-1	38	Smooth Chert Savannah	47	3	50
NaA	Newtonia silt loam, 0 to 1 percent slopes	21	I-2	35	Loamy Prairie	45	--	--
NaB	Newtonia silt loam, 1 to 3 percent slopes	21	IIe-1	35	Loamy Prairie	45	--	--
NaC	Newtonia silt loam, 3 to 5 percent slopes	21	IIIe-1	37	Loamy Prairie	45	--	--
NaC2	Newtonia silt loam, 2 to 5 percent slopes, eroded	21	IIIe-3	37	Loamy Prairie	45	--	--
OeA	Okemah silt loam, 0 to 1 percent slopes	23	I-2	35	Loamy Prairie	45	--	--
OkA	Okemah silty clay loam, 0 to 1 percent slopes	23	I-2	35	Loamy Prairie	45	--	--
OkB	Okemah silty clay loam, 1 to 3 percent slopes	23	IIe-1	35	Loamy Prairie	45	--	--
OkC	Okemah silty clay loam, 3 to 5 percent slopes	23	IIIe-4	37	Loamy Prairie	45	--	--
Os	Osage clay	24	IIIw-1	38	Heavy Bottomland	44	1	49
PaA	Parsons silt loam, 0 to 1 percent slopes	25	IIs-1	36	Claypan Prairie	44	-	--
Rs	Rough stony land	25	VIIs-4	40	Breaks	43	--	--
SgB	Sallisaw gravelly silt loam, 1 to 3 percent slopes	26	IIe-2	36	Smooth Chert Savannah	47	3	50
SgD	Sallisaw gravelly silt loam, 3 to 8 percent slopes	26	IVe-1	38	Smooth Chert Savannah	47	3	50
SaA	Sallisaw silt loam, 0 to 1 percent slopes	26	I-1	34	Smooth Chert Savannah	47	2	50
SaB	Sallisaw silt loam, 1 to 3 percent slopes	26	IIe-2	36	Smooth Chert Savannah	47	2	50
Sn	Staser gravelly loam	27	IIw-3	36	Loamy Bottomland	45	1	49
Sm	Staser silt loam	27	IIw-1	36	Loamy Bottomland	45	1	49
SrA	Stigler silt loam, 0 to 1 percent slopes	28	IIw-2	36	Smooth Chert Savannah	47	5	52
SuC2	Summit silty clay loam, 2 to 5 percent slopes, eroded	29	IIIe-5	37	Loamy Prairie	45	--	--
TkA	Taloka silt loam, 0 to 1 percent slopes	30	IIs-1	36	Loamy Prairie	45	--	--
TrD	Talpa-Rock outcrop complex, 2 to 8 percent slopes	30	VIIs-2	39	Very Shallow	47	--	--
TrF	Talpa-Rock outcrop complex, 15 to 50 percent slopes	30	VIIs-3	40	Very Shallow	47	--	--
Vd	Verdigris silt loam	31	IIw-1	36	Loamy Bottomland	45	1	49
Vr	Verdigris soils, frequently flooded	31	Vw-2	38	Loamy Bottomland	45	1	49
WoA	Woodson silt loam, 0 to 1 percent slopes	32	IIs-1	36	Claypan Prairie	44	--	--

[1] The soils in Cherokee and Delaware Counties are not all named the same as those that join them in adjacent Adair and Ottawa Counties. This is due to refinements in the soil series concepts resulting from the new system of soil classification.

351-985 O - 70 (paster)

1

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Land division corners are approximately positioned on this map.
CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 1

(Joins sheet 2)

(Joins sheet 6)

N

1 Mile
5000 Feet
Scale 1:20000

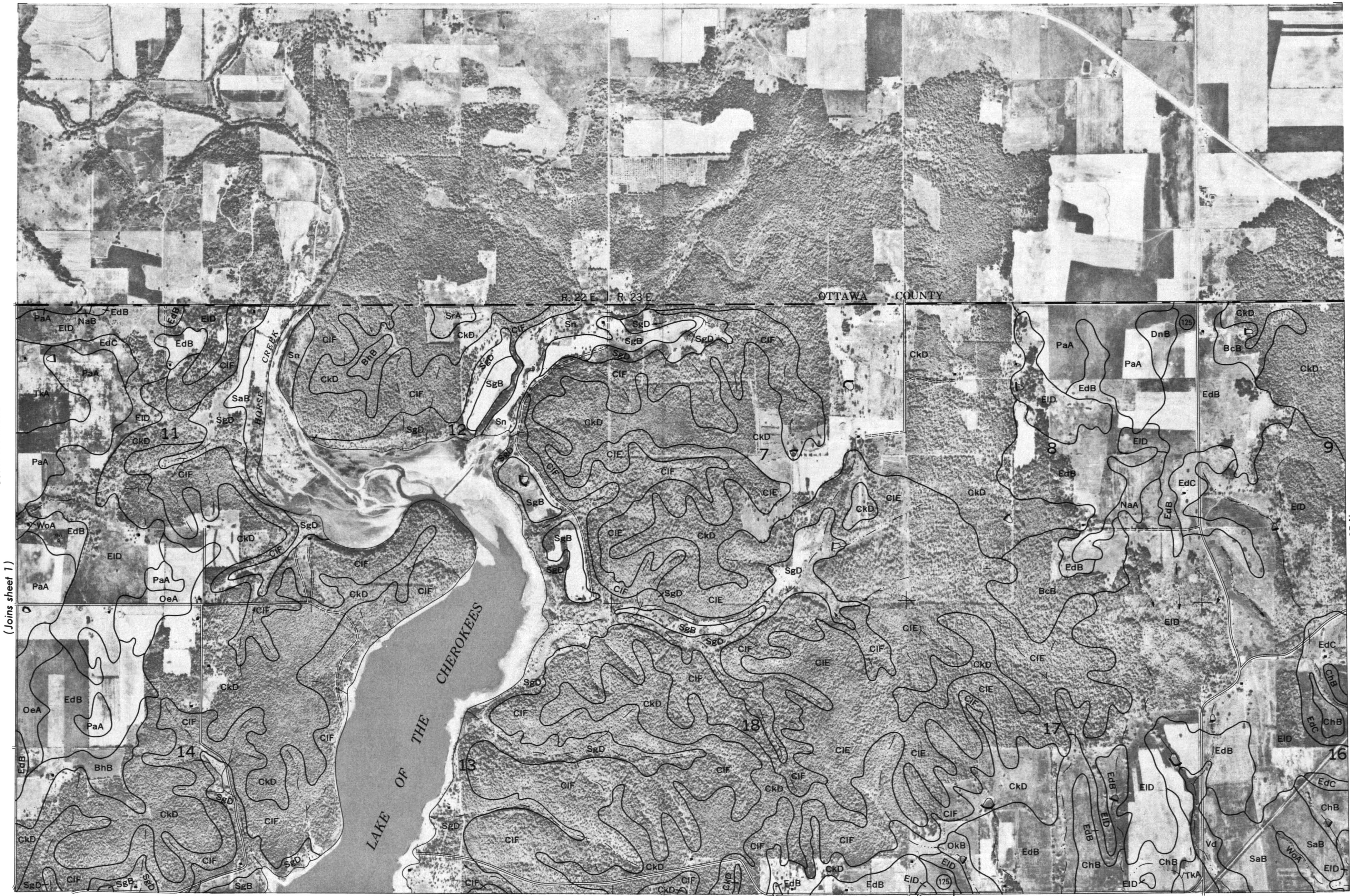
2

N

1 Mile
5000 Feet

Scale 1:20000

(Joins sheet 1)



(Joins sheet 3)

(Joins sheet 7)

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 2

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1959 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

3

N

1 Mile
5000 Feet
Scale 1:20000

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 3

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 4

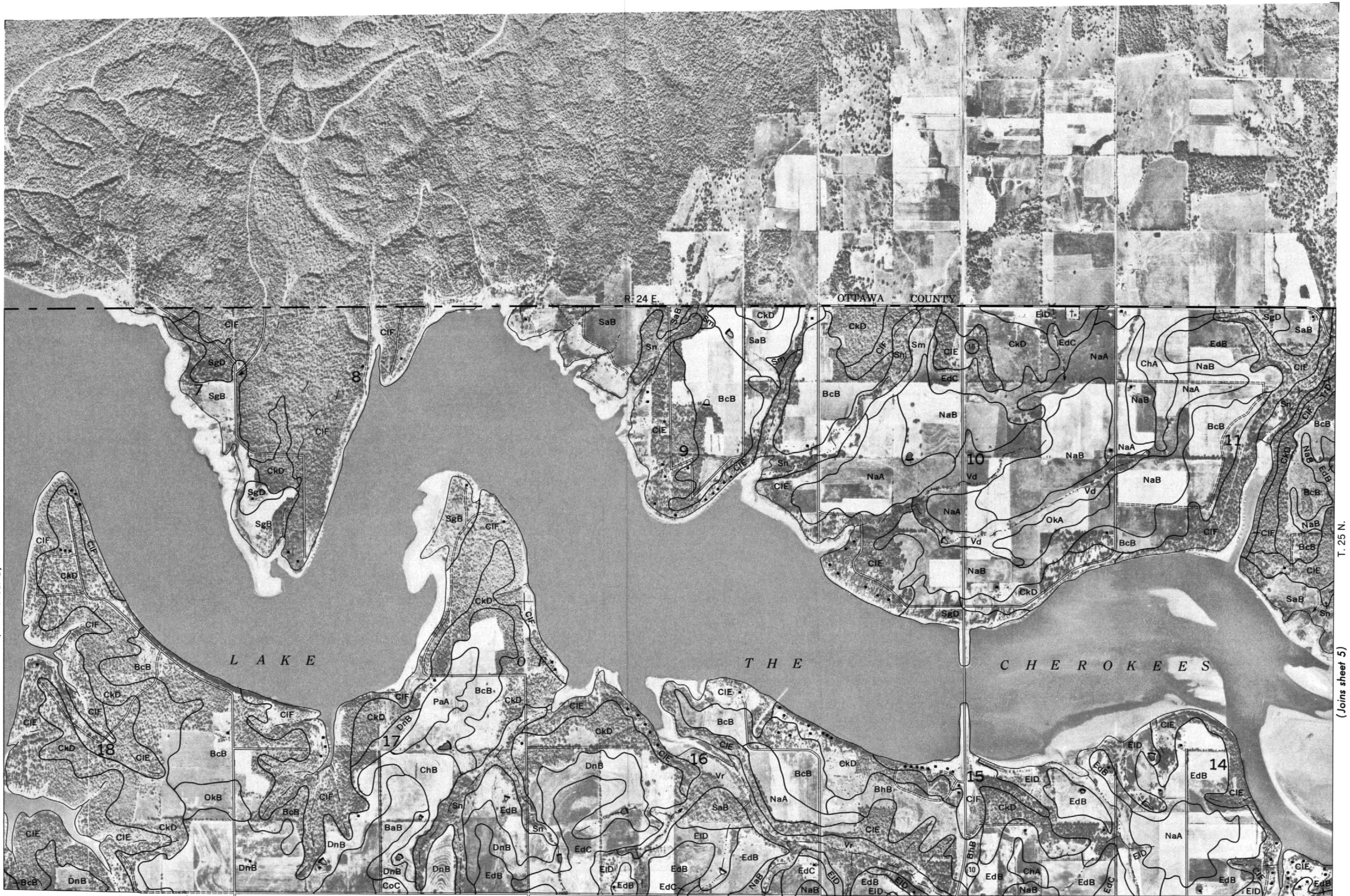
N

Scale 1:20000

1 Mile · 3/4 · 1/2 · 1/4 · 0

5000 Feet · 4000 · 3000 · 2000 · 1000 · 0

(Joins sheet 3)



(Joins sheet 5)

(Joins sheet 9)

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 4

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

5

N

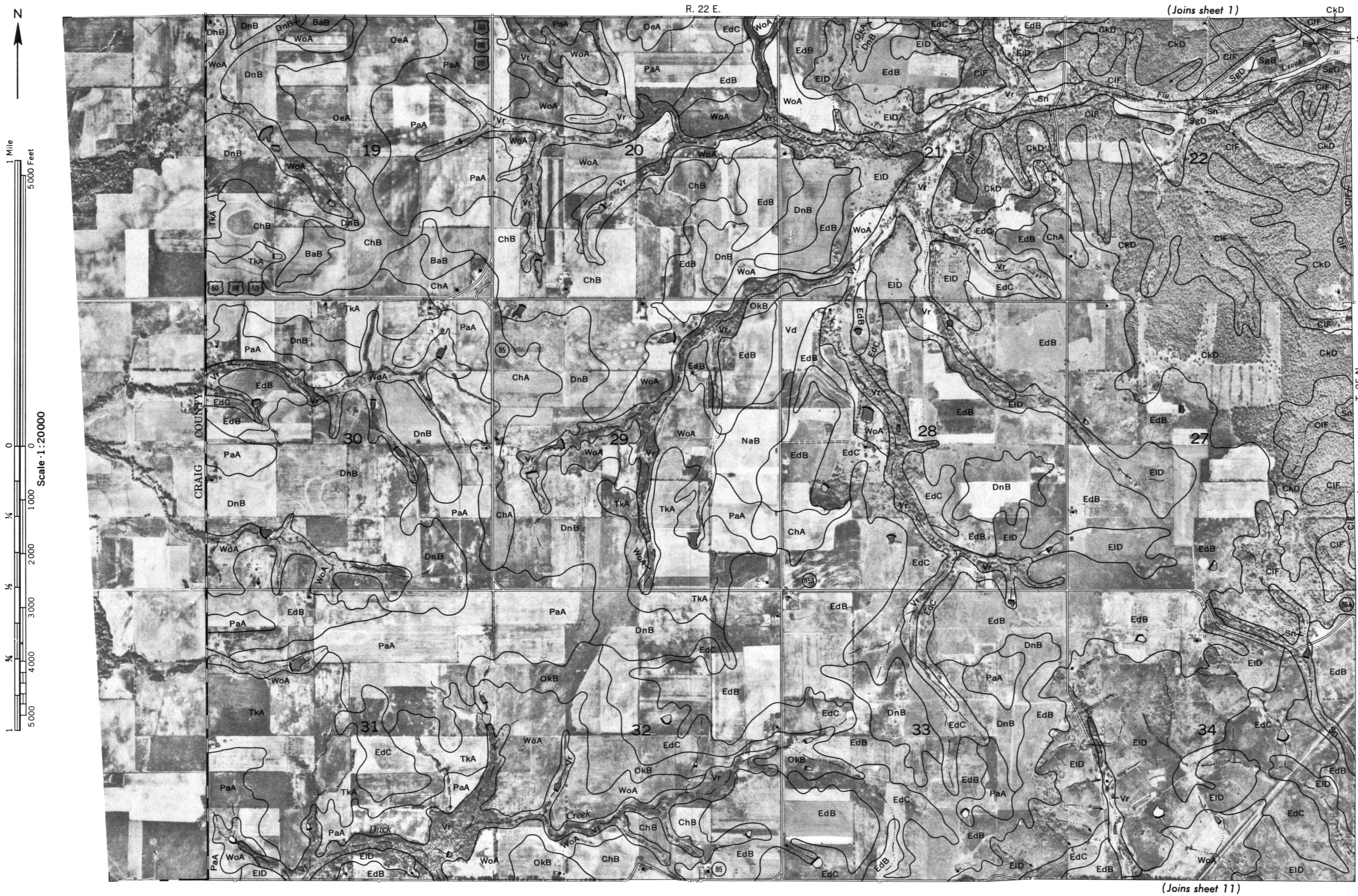
(Joins sheet 4)

(Joins sheet 10)

1 Mile
5000 Feet
Scale 1:20000
0 1000 2000 3000 4000 5000
0 ¼ ½ ¾ 1

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Land division corners are approximately positioned on this map.
CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 5

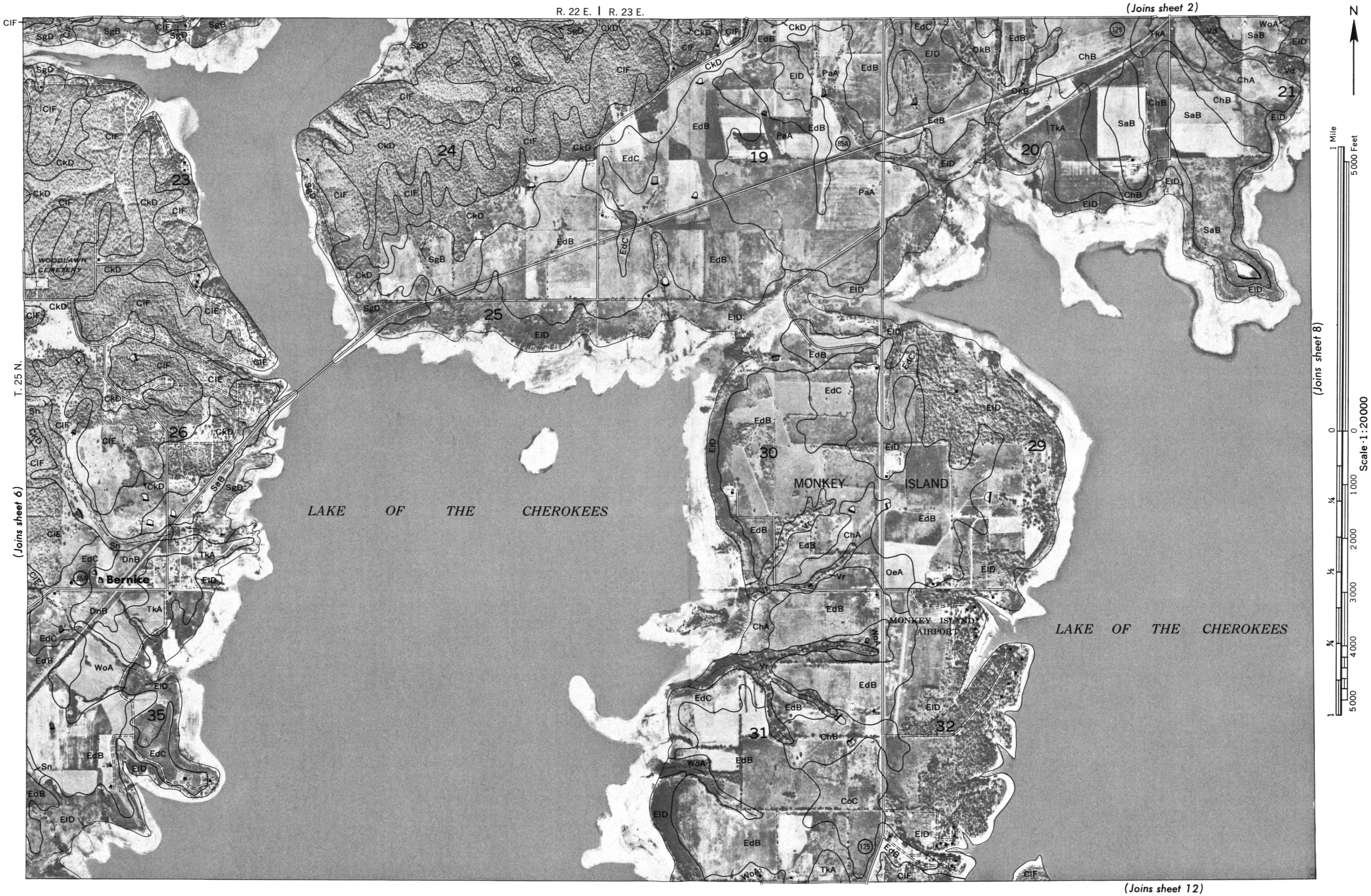
CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 6



CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 6

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.



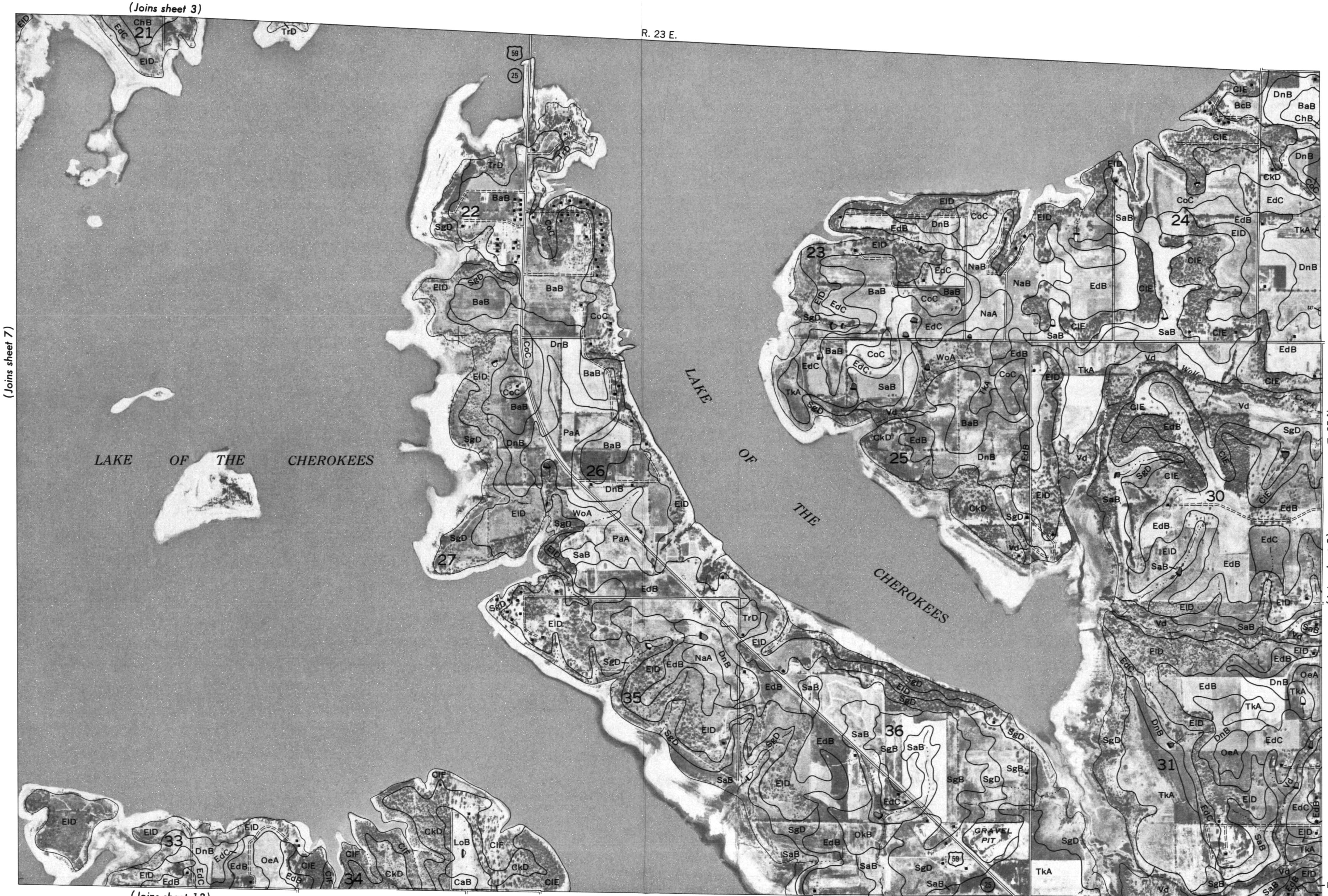
This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Land division corners are approximately positioned on this map.
CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 7

N

Scale 1:20000

1 Mile ¾ ½ ¼ 0

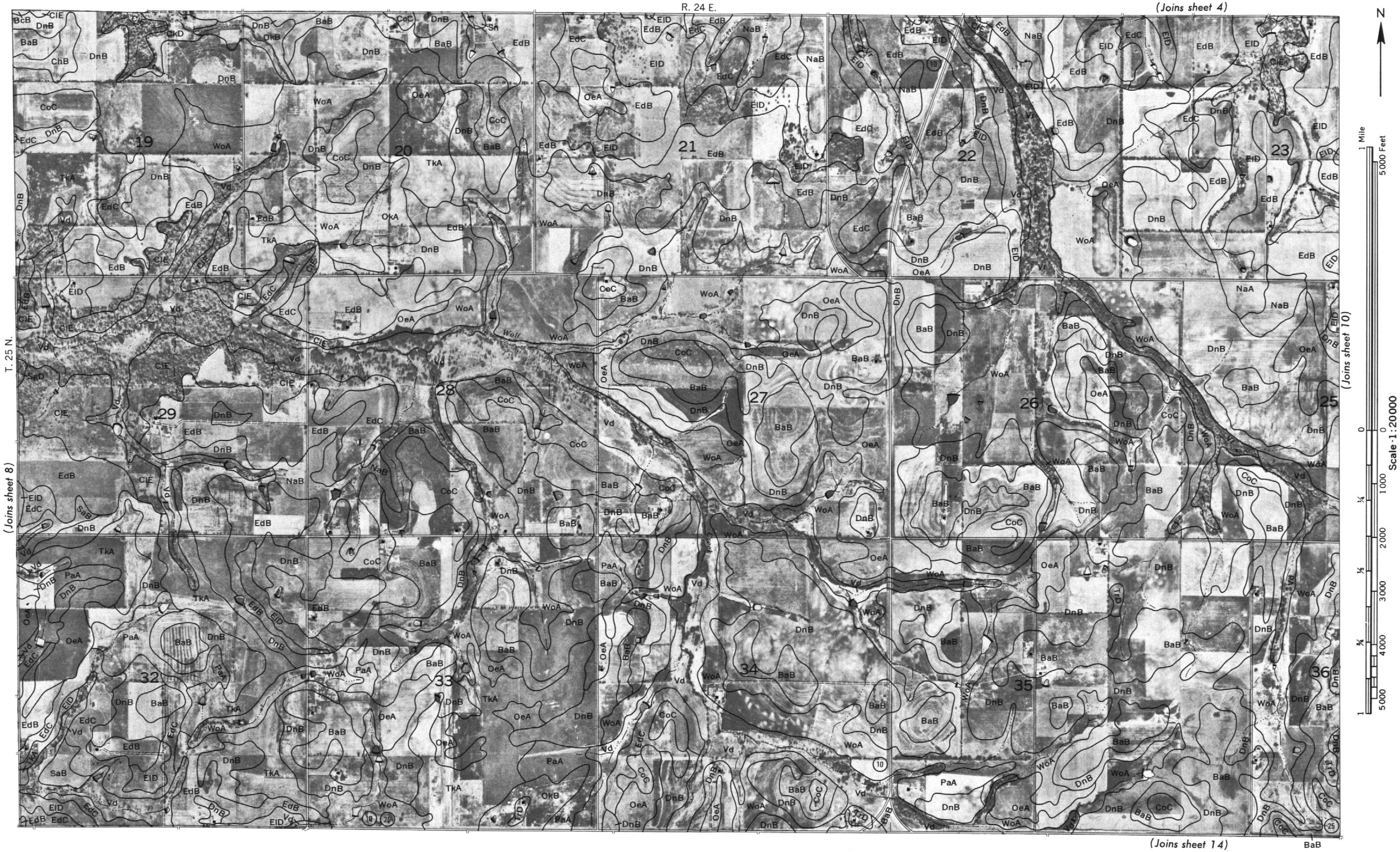
5000 Feet 4000 3000 2000 1000 0 5000



CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 8

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.



This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 9

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 10

Land division corners are approximately positioned on this map.

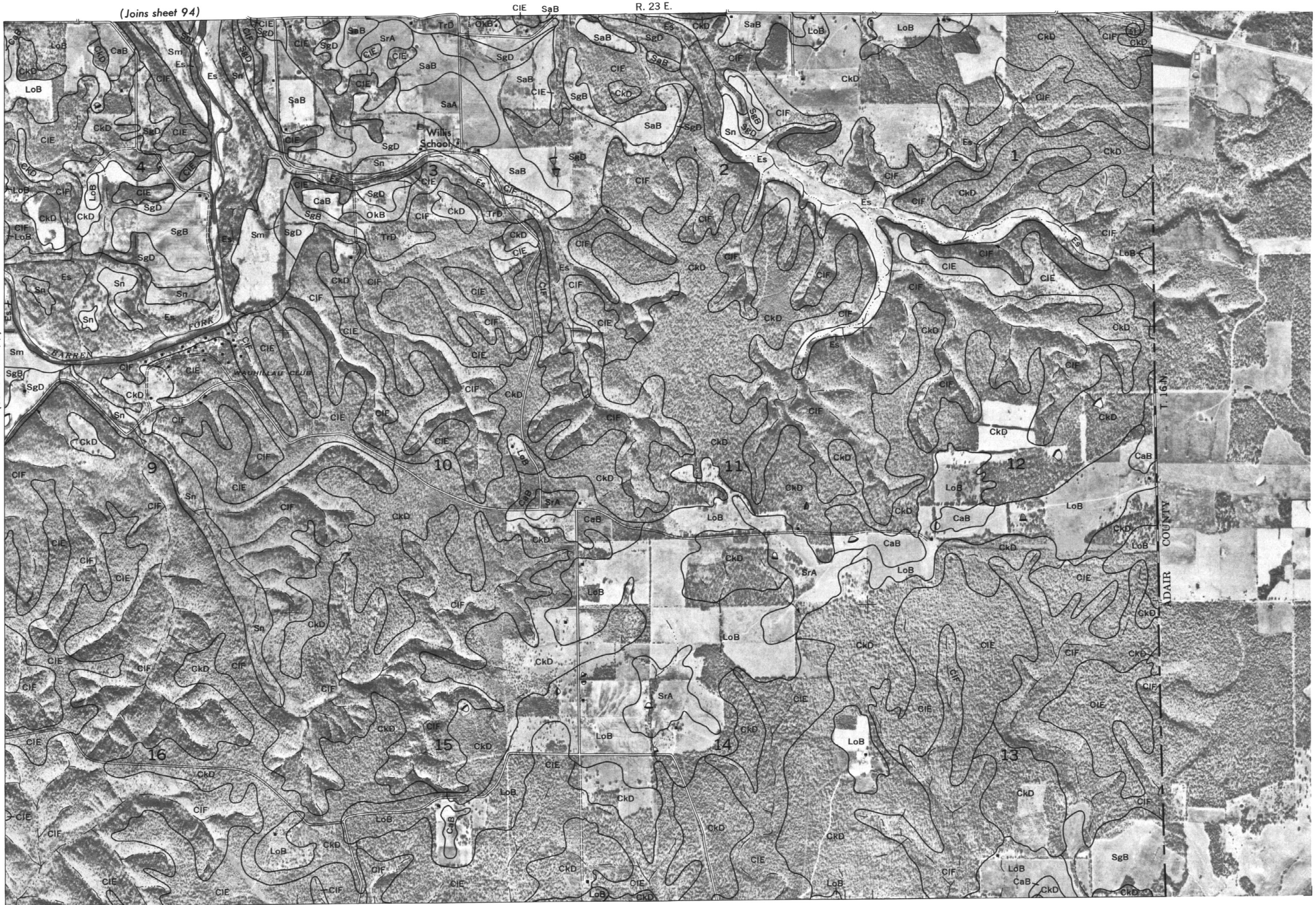
This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 10

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 100

N

(Joins sheet 94)



(Joins sheet 106)

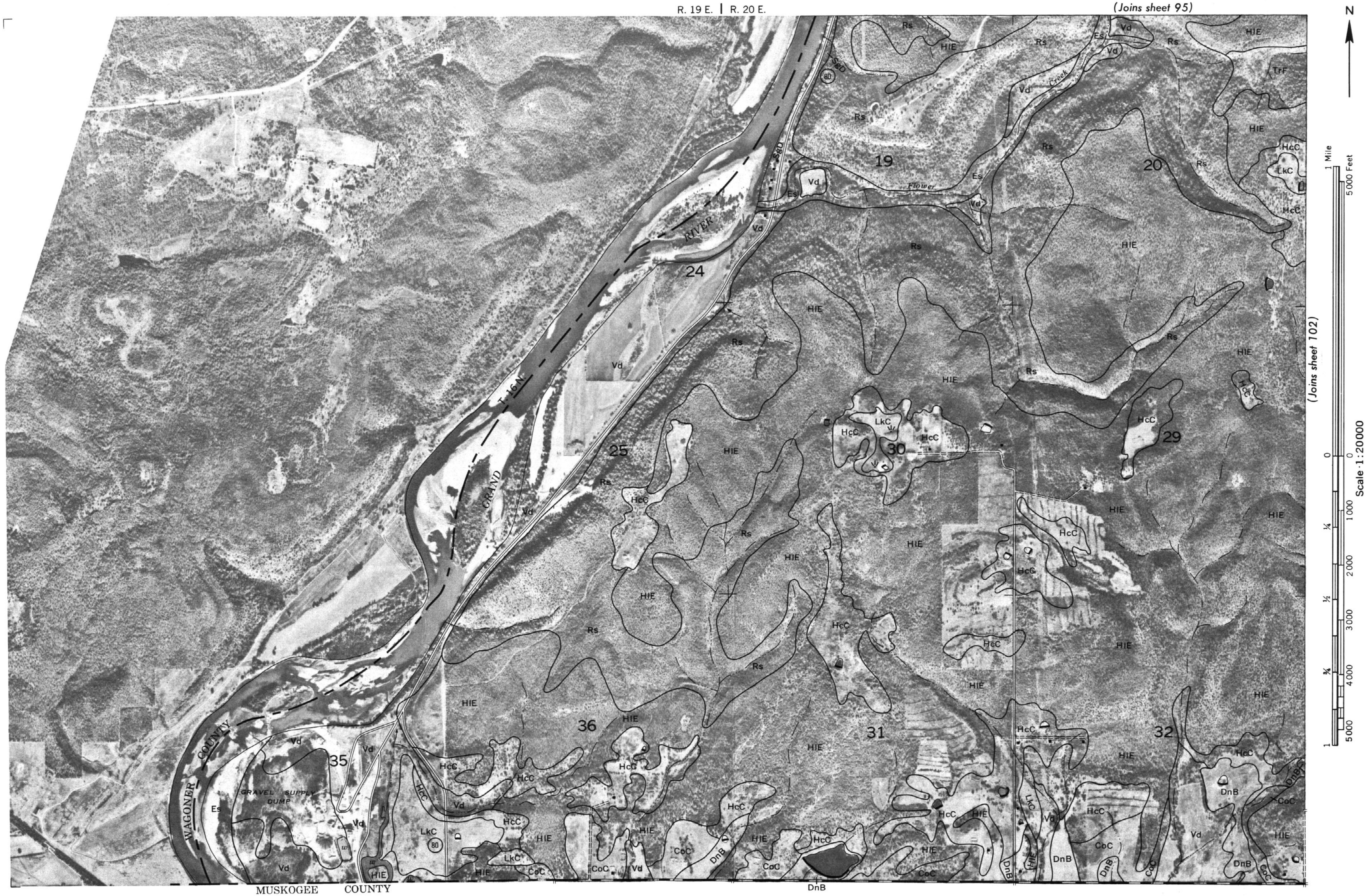
1 Mile
5000 Feet
Scale 1:20000
0 1000 2000 3000 4000 5000

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 100

Land division corners are approximately positioned on this map.

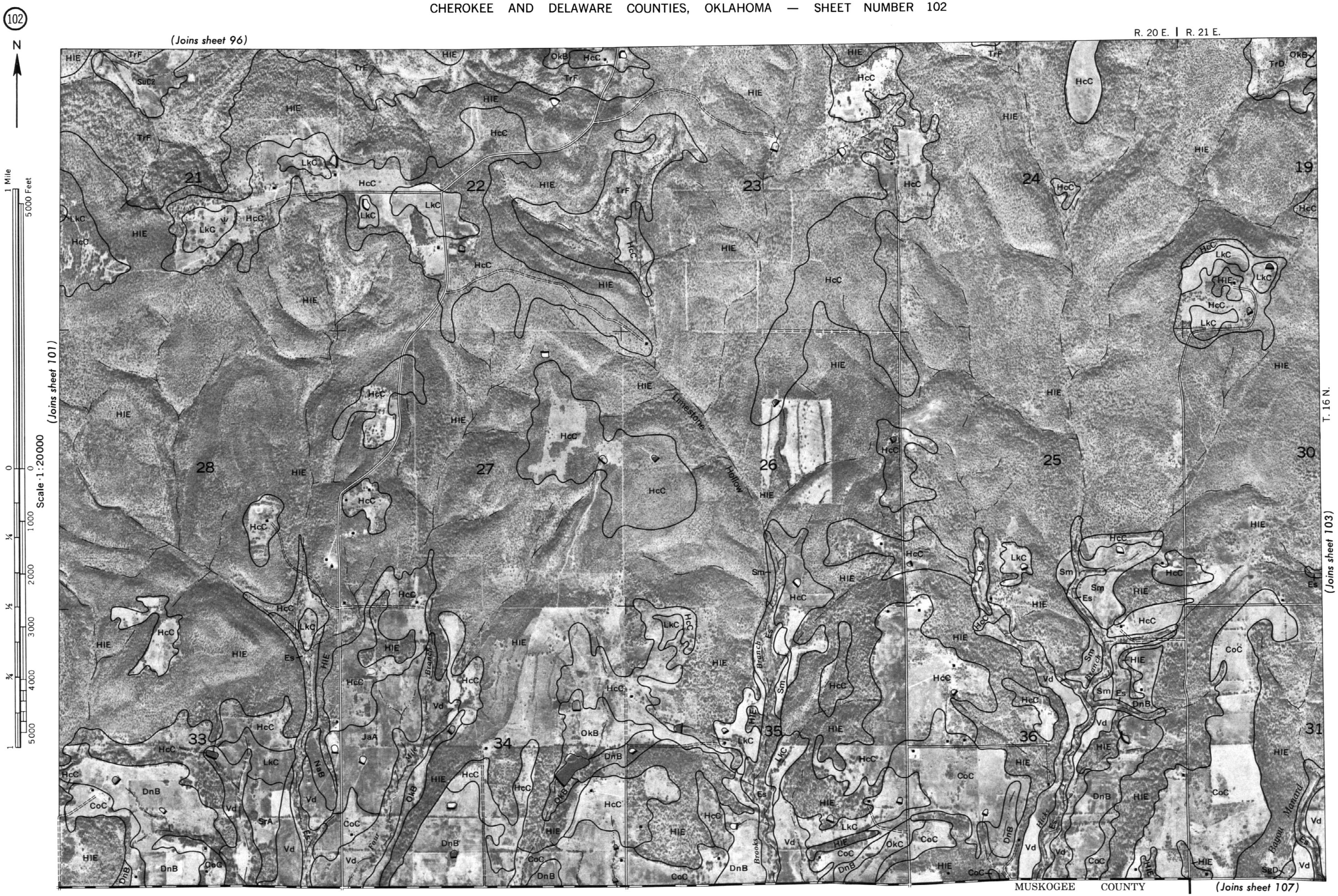
This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

101



This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 101

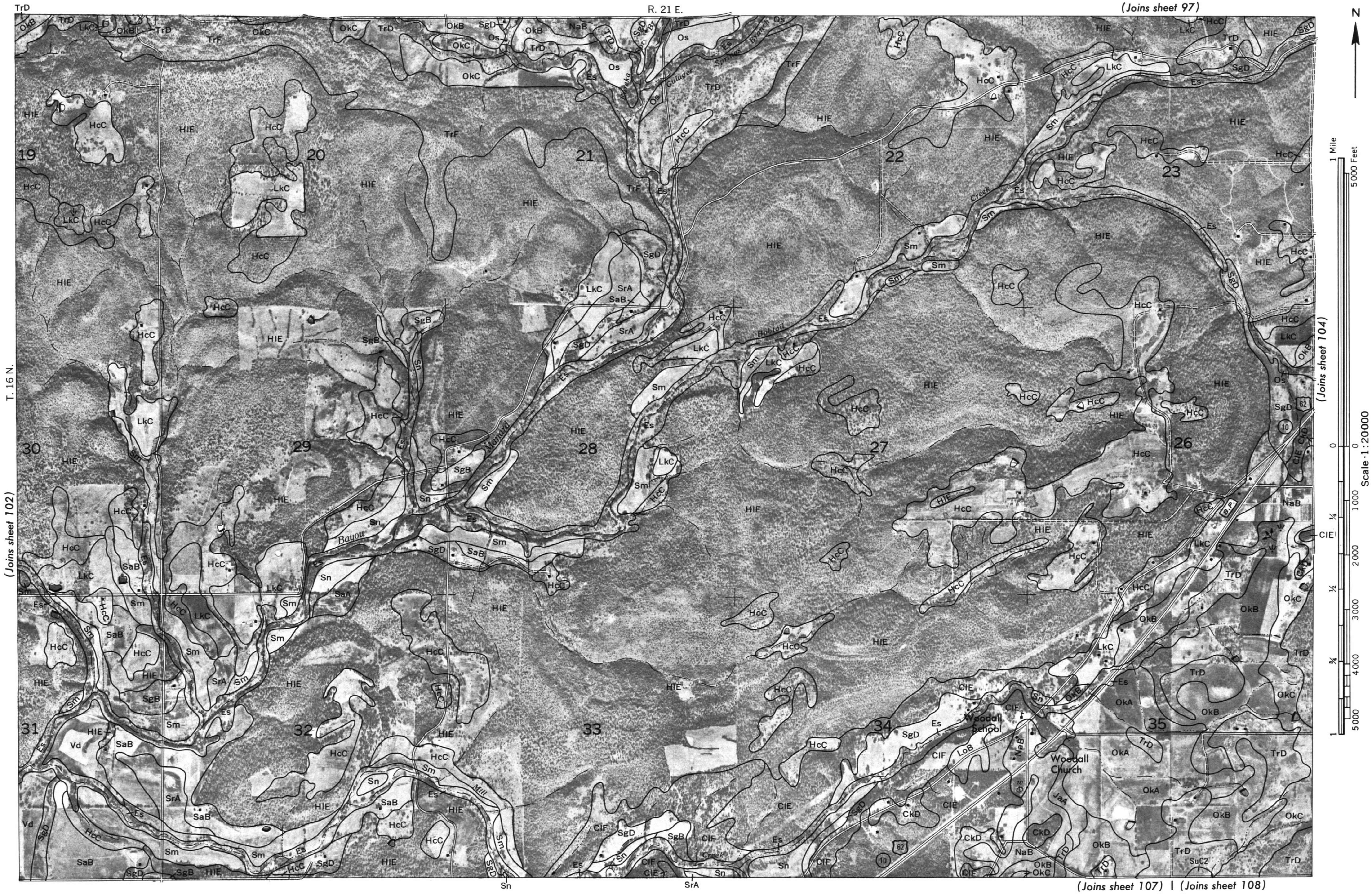


CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 102

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

103



This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 103

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 104

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 104

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

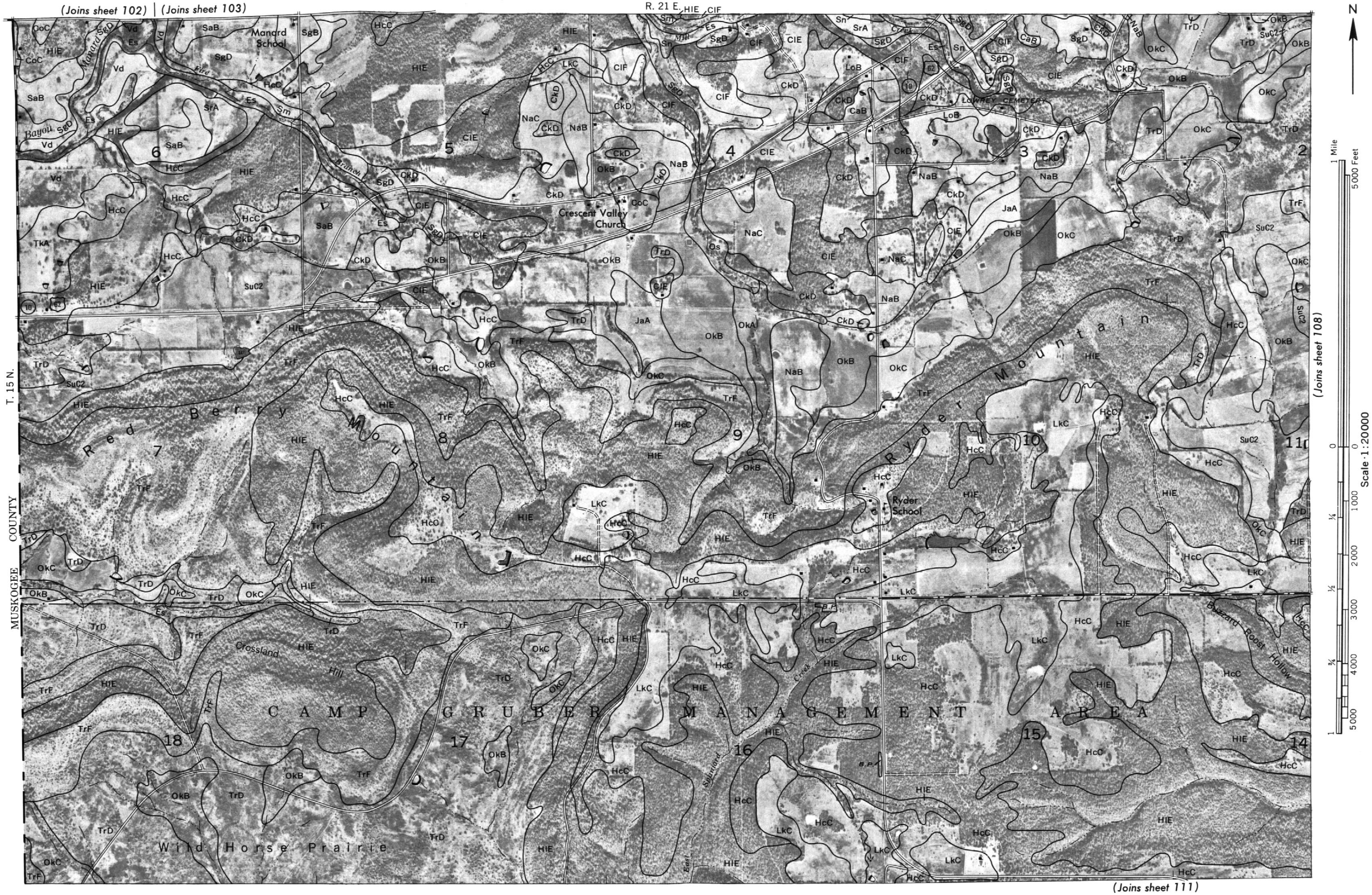
CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 105

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 106

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 106

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.



This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 108

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 108

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

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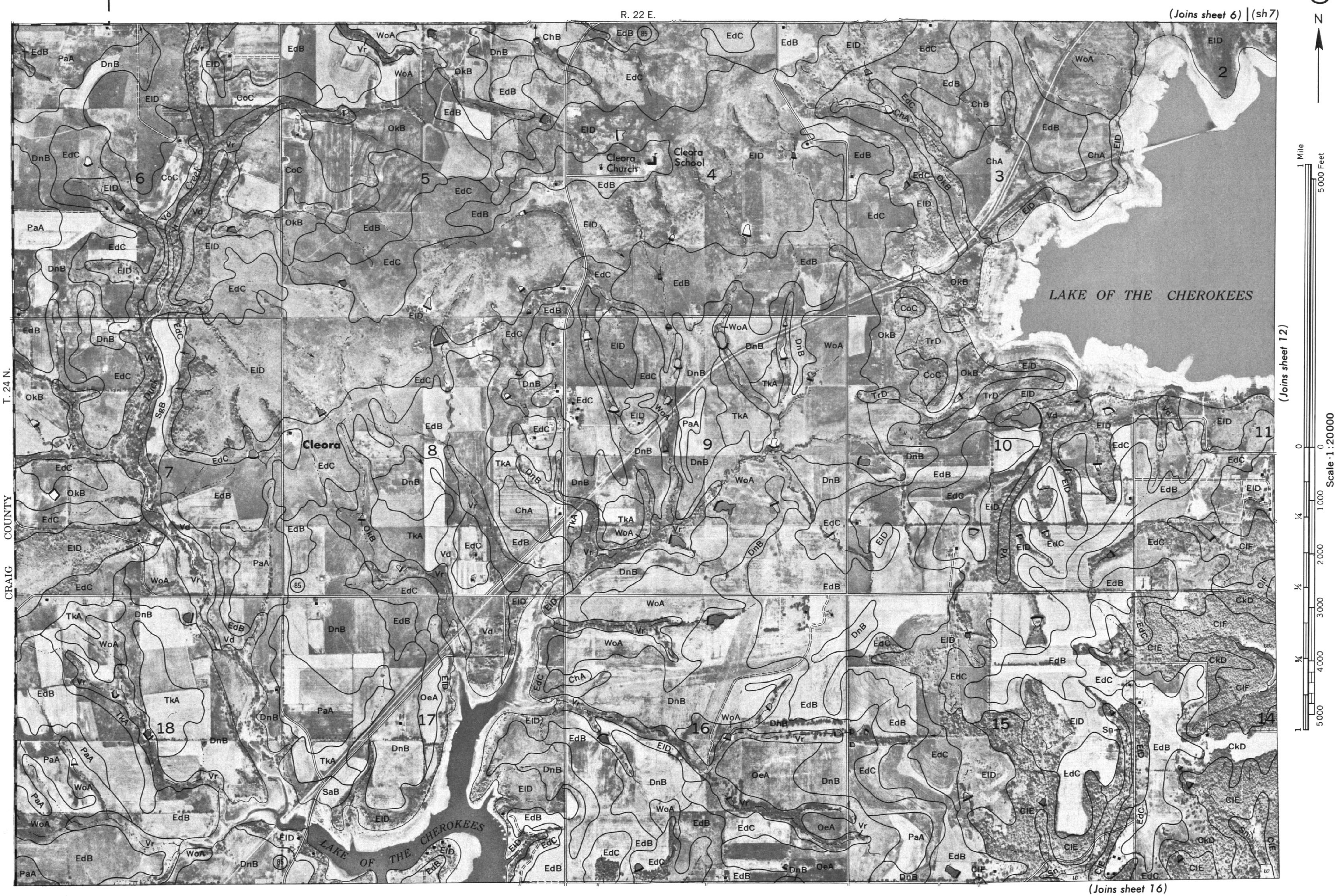
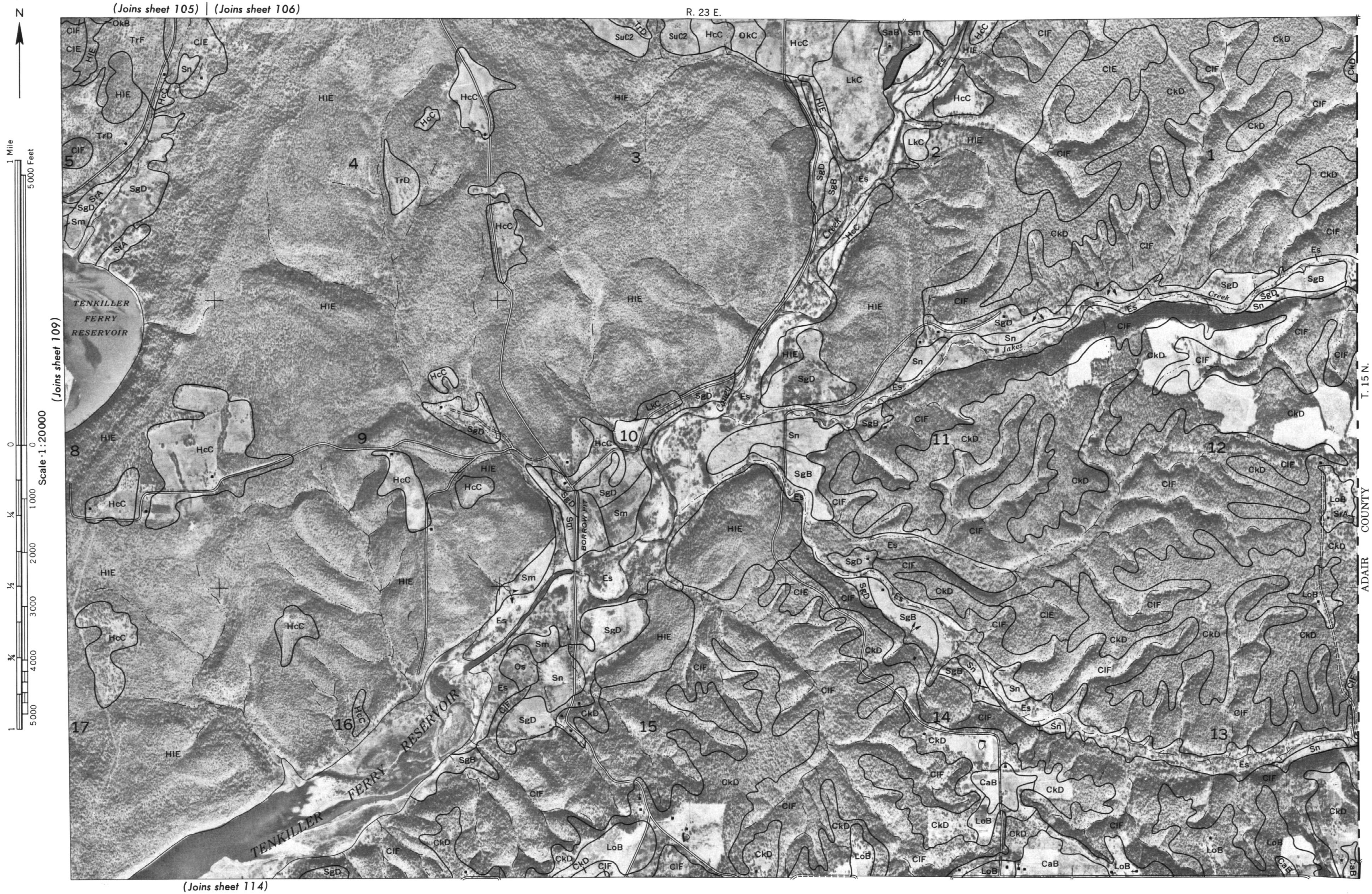
Land division corners are approximately positioned on this map.



This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 11



CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 110

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

111

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 111

N

(Joins sheet 108)

R. 21 E. | R. 22 E.

(Joins sheet 111)

(Joins sheet 113)

T. 15 N.

(Joins sheet 116)

Scale 1:20000

1 Mile: 0, 1/4, 1/2, 3/4, 1

5000 Feet: 0, 1000, 2000, 3000, 4000, 5000

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 112

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

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Land division corners are approximately positioned on this map.

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 113

T. 15 N.

R. 22 E. | R. 23 E.

(Joins sheet 109)

(Joins sheet 112)

(Joins sheet 114)

(Joins sheet 117)

N

1 Mile

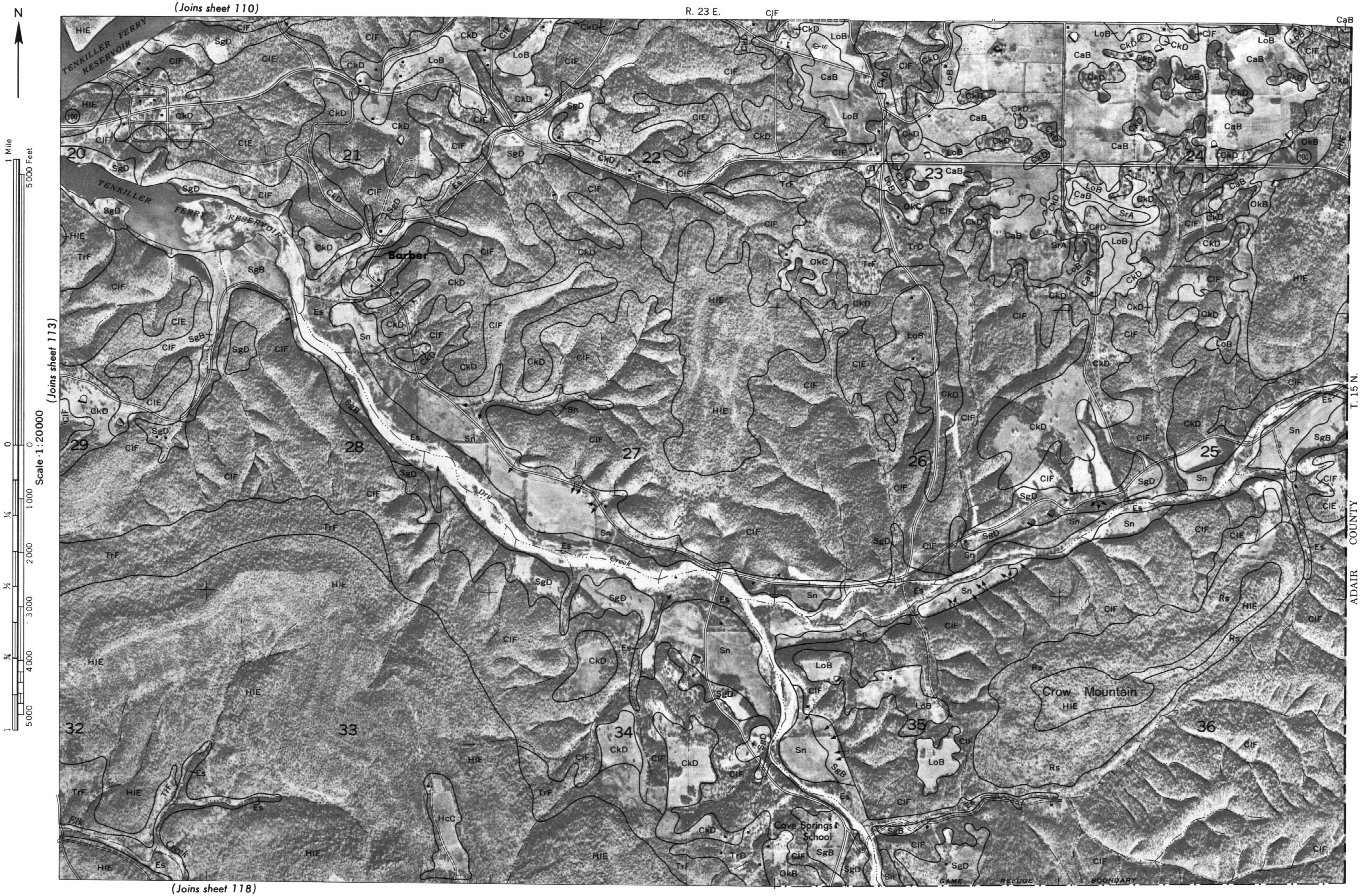
5000 Feet

0 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000

Scale 1:20000

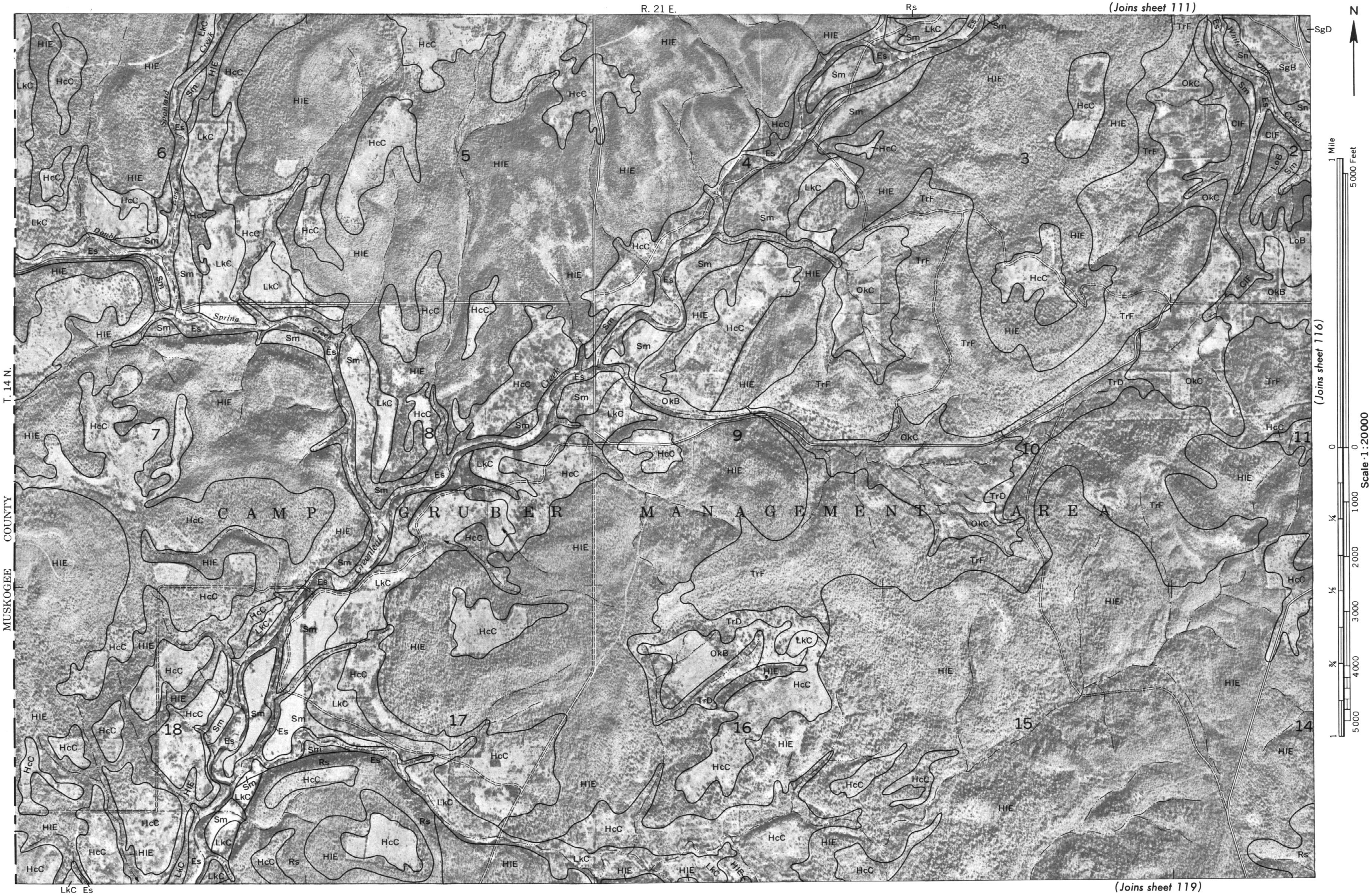
CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 114



CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 114

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.



This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 116

N

(Joins sheet 112)

R. 21 E. | R. 22 E.

(Joins sheet 115)

(Joins sheet 117)

(Joins sheet 120)

1 Mile

5000 Feet

Scale 1:20000

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 116

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

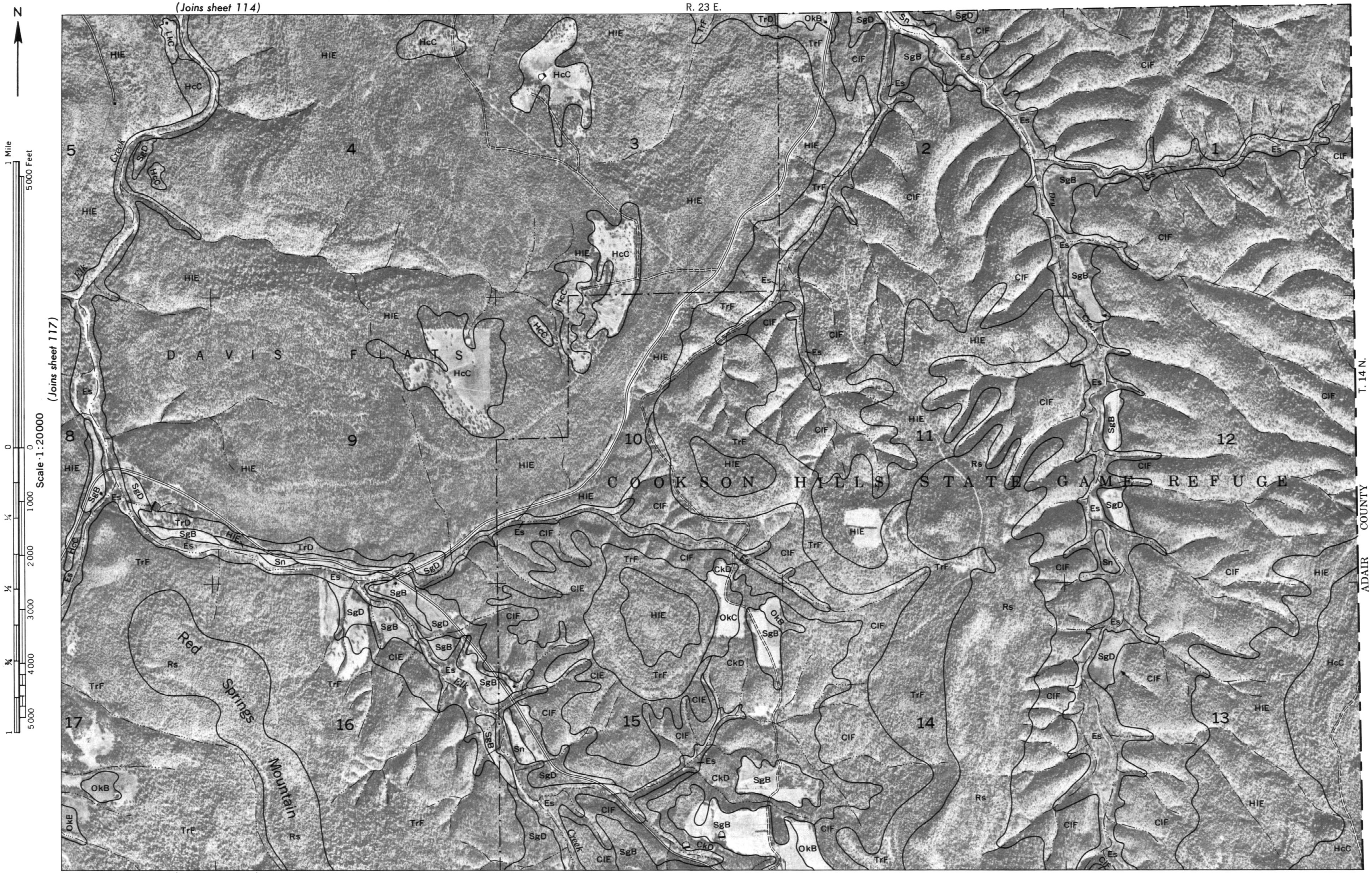
117

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 117

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 118

(Joins sheet 114)



(Joins sheet 122)

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 118

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

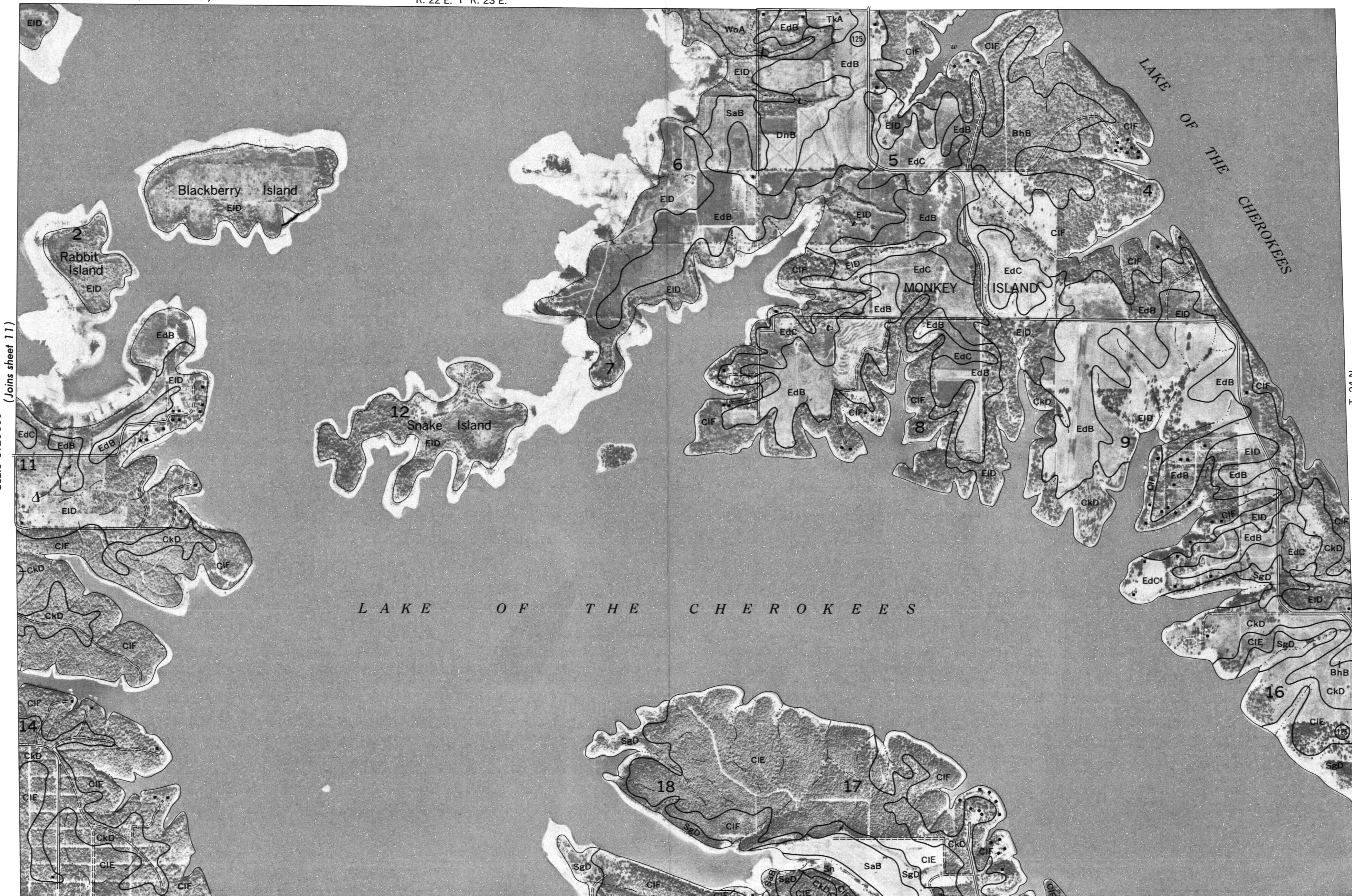
This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

N

(Joins sheet 7)

R. 22 E. | R. 23 E.



(Joins sheet 11)

(Joins sheet 13)

T. 24 N.

(Joins sheet 17)

Scale 1:20000

1 Mile — 5000 Feet

0 — ¼ — ½ — ¾ — 1

0 — 1000 — 2000 — 3000 — 4000 — 5000

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 12

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

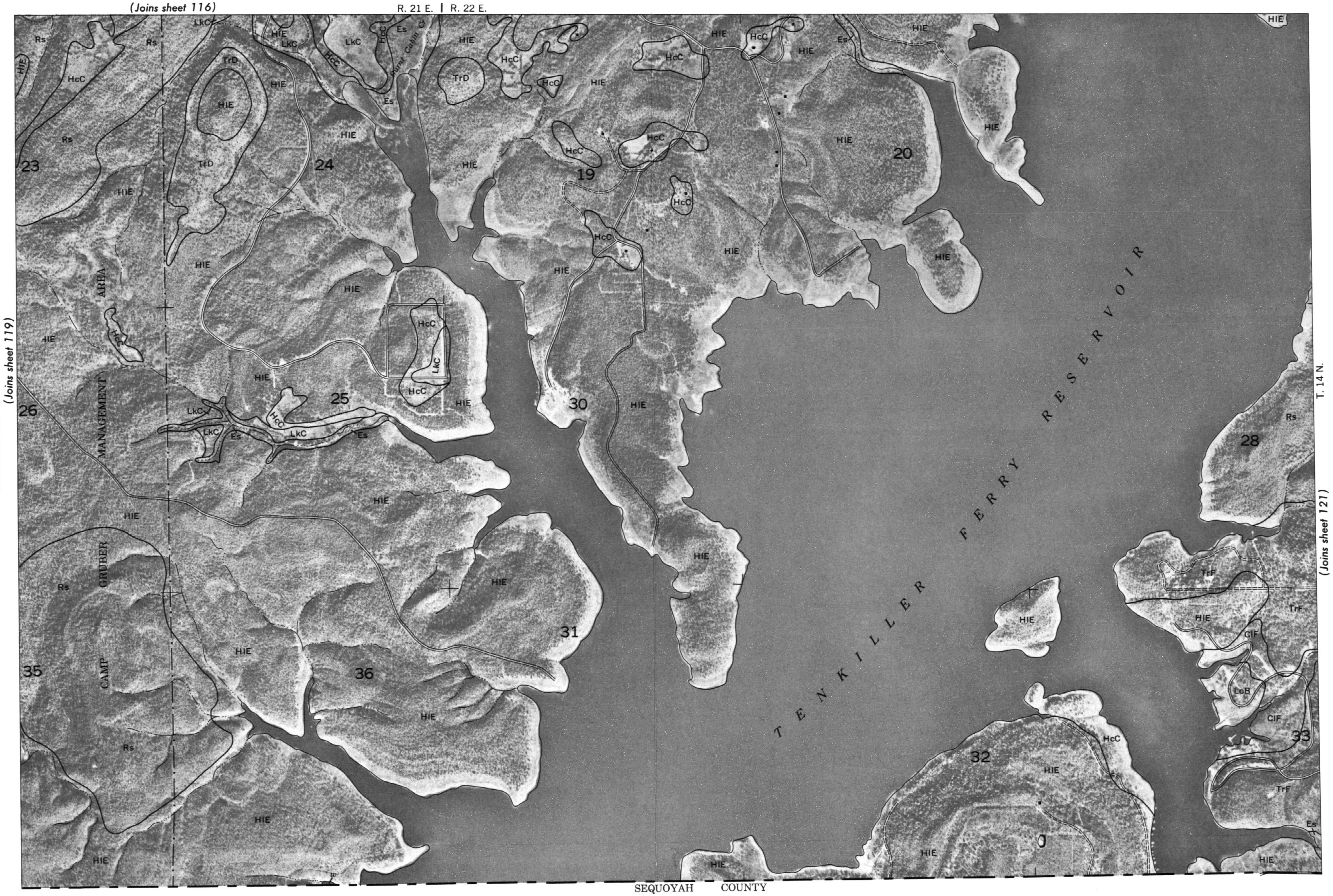
CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 120

N

(Joins sheet 116)

R. 21 E. | R. 22 E.

(Joins sheet 119)



(Joins sheet 121)

T. 14 N.

SEQUOYAH COUNTY

1 Mile
5000 Feet
Scale 1:20000
0 ¼ ½ ¾ 1
0 1000 2000 3000 4000 5000

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 120

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

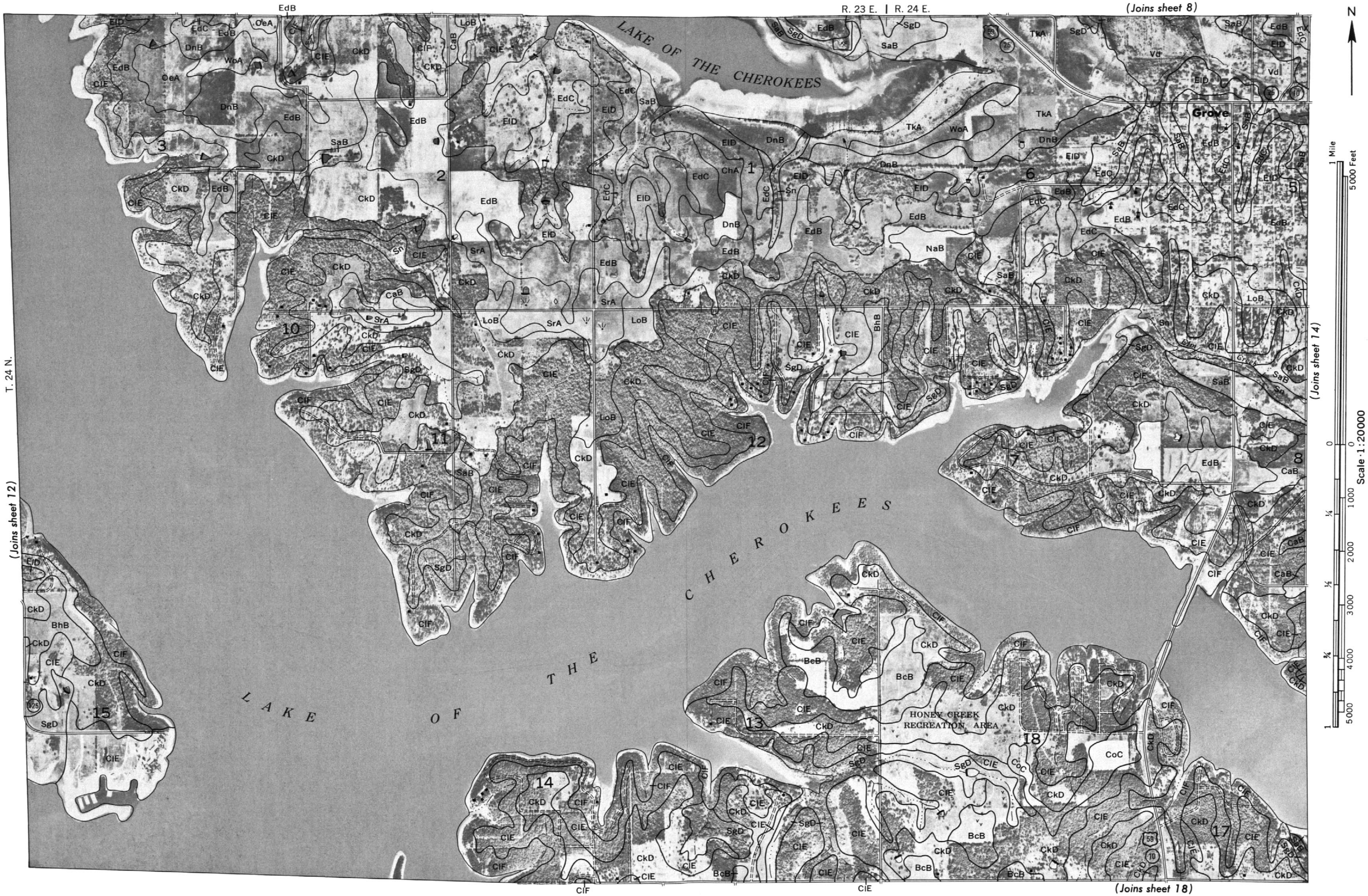
(121)

Land division corners are approximately positioned on this map.
CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 121

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 122

Land division corners are approximately positioned on this map.

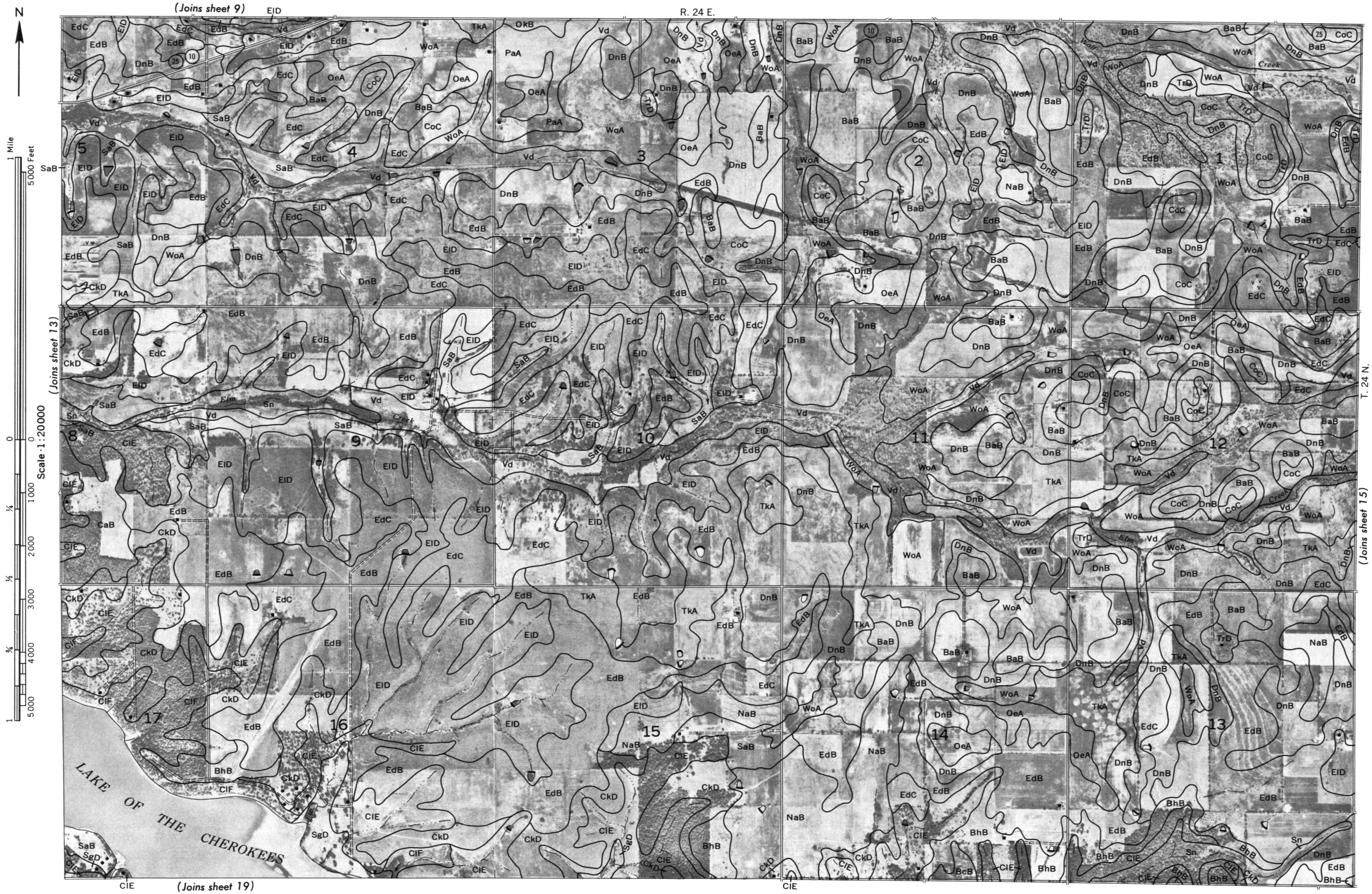
This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.



This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

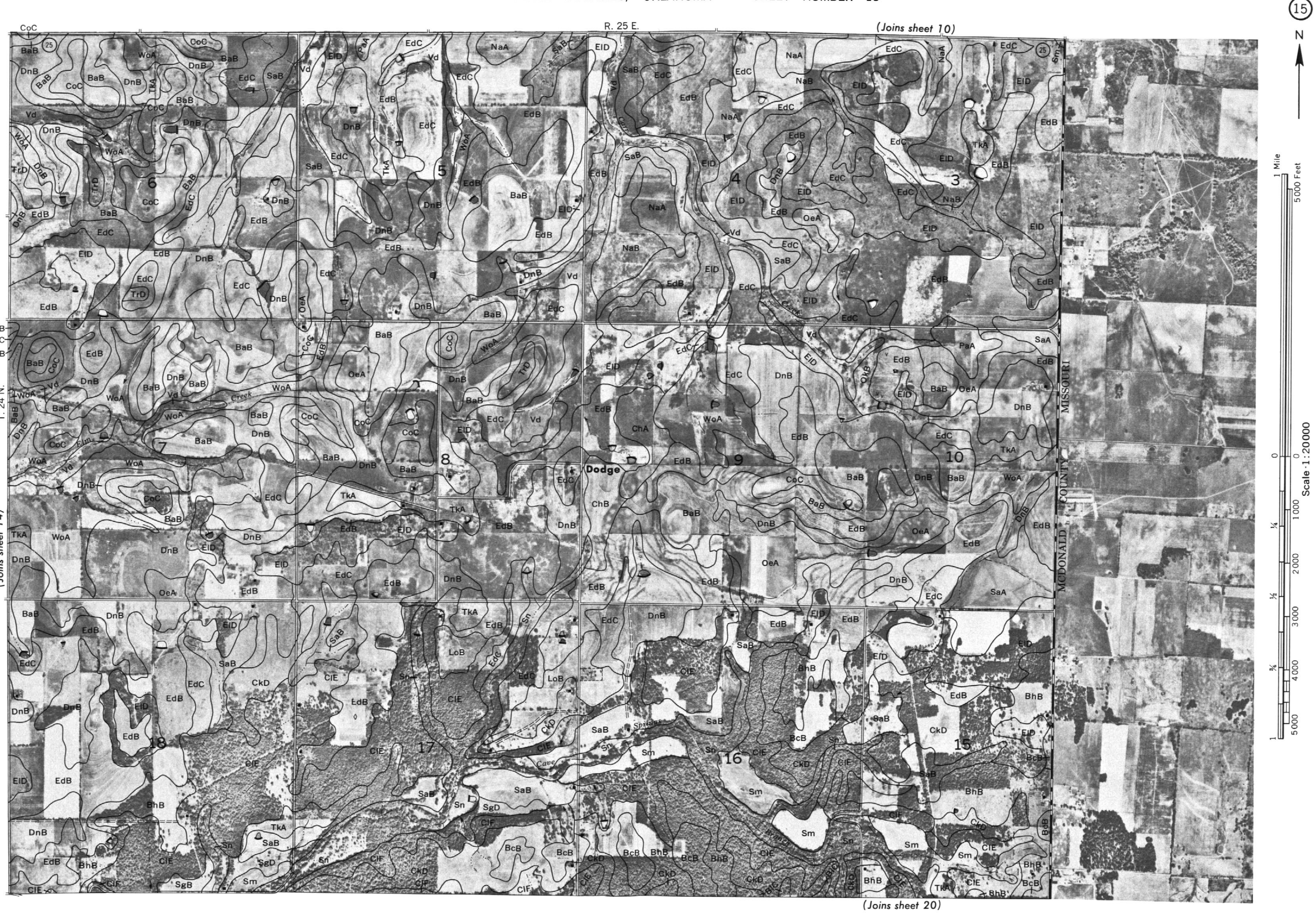
CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 13



CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 14

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.



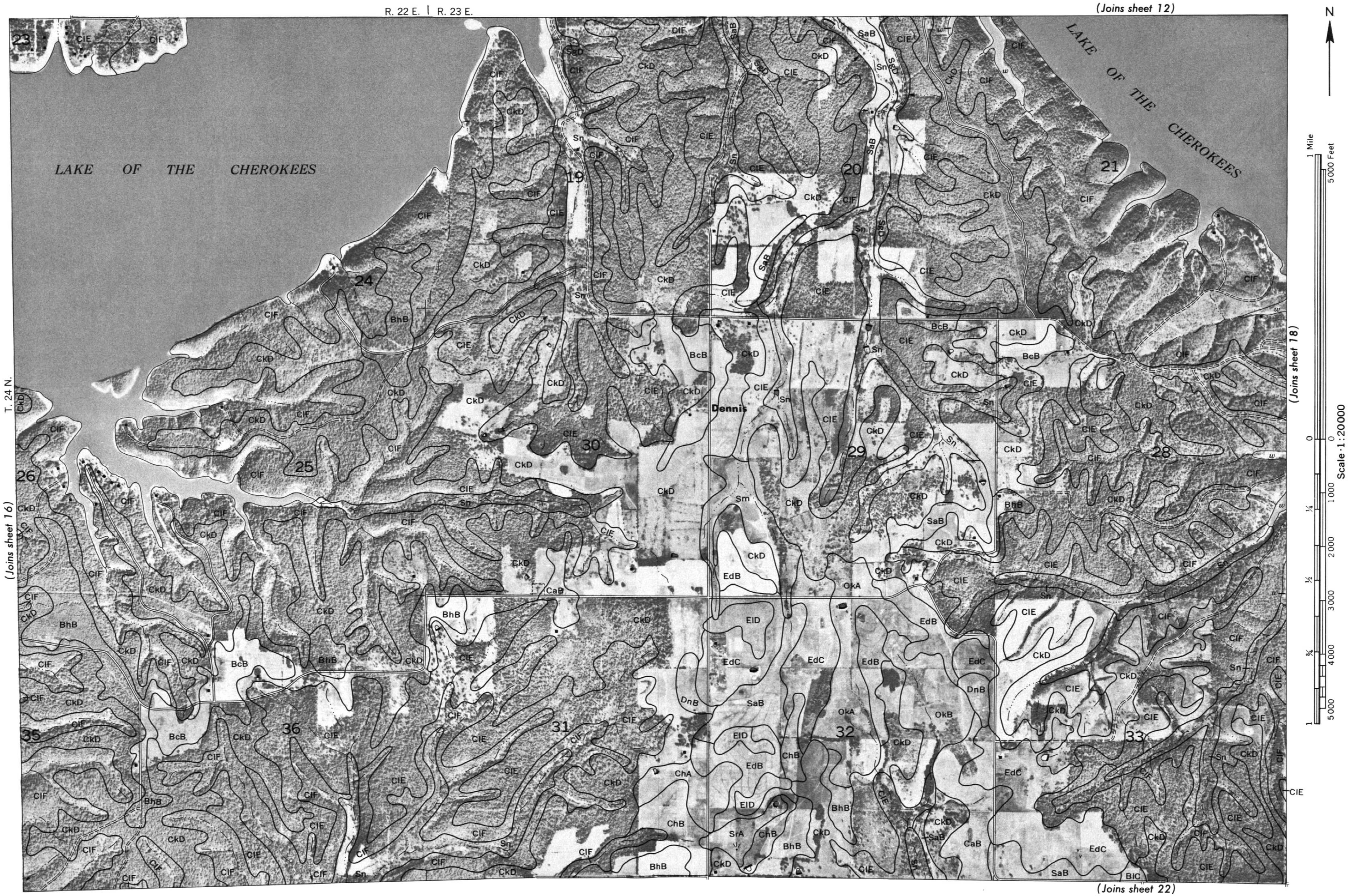
This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 15

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 16

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.



This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 17

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 18

N

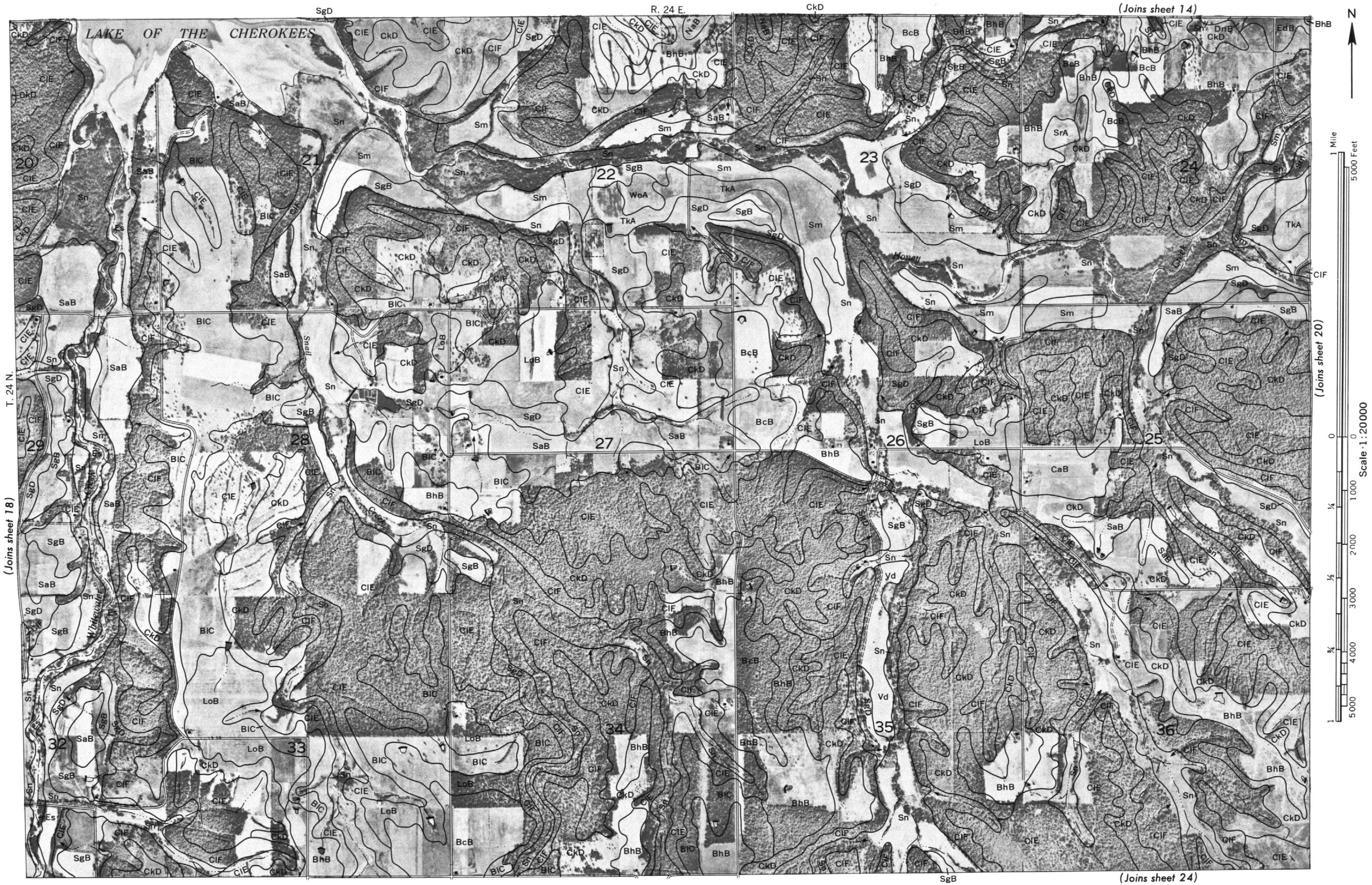
1 Mile 5000 Feet

Scale 1:20000

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 18

Land division corners are approximately positioned on this map.

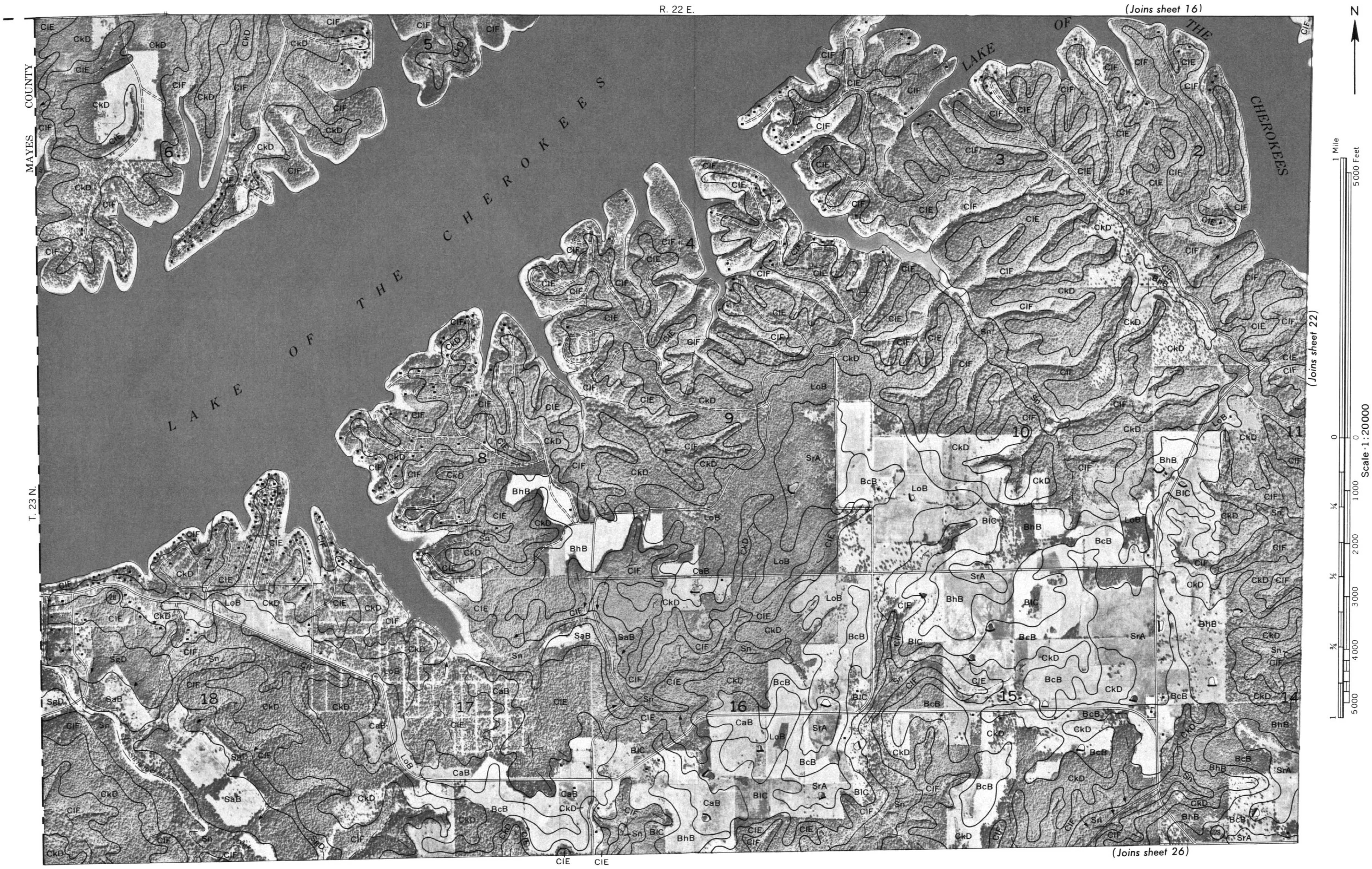
This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.



This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.



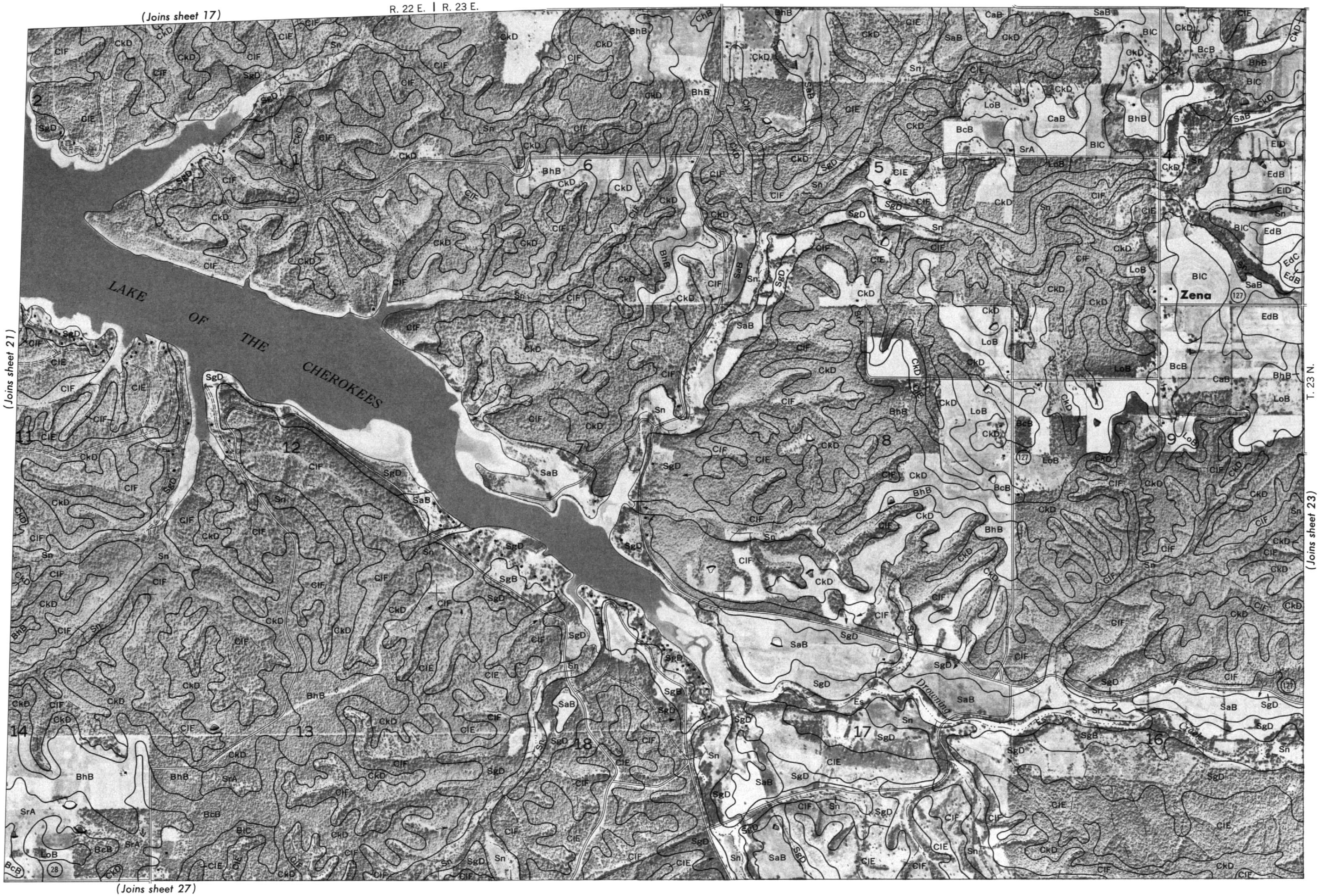
This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 22

N

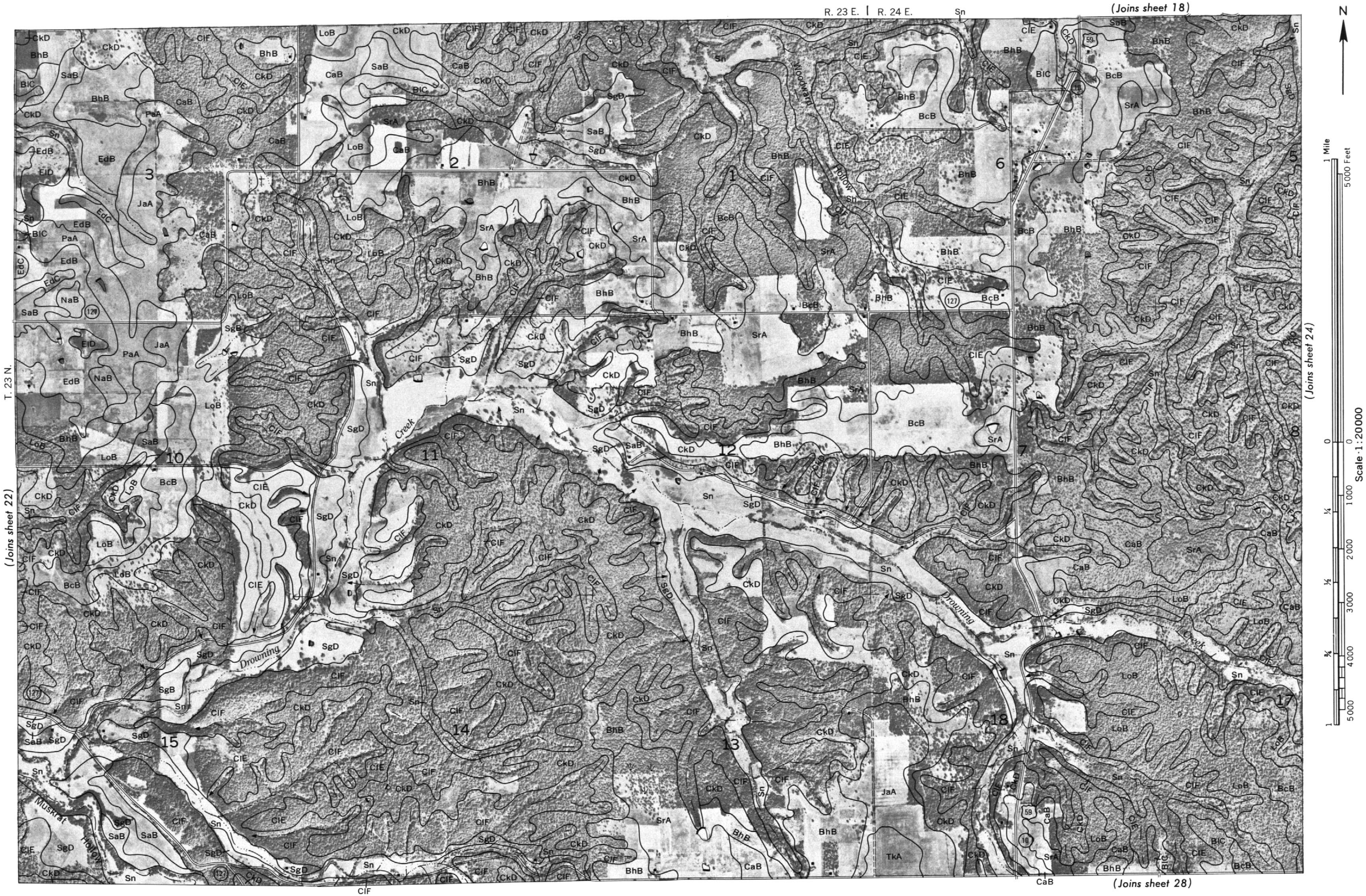
1 Mile
5000 Feet
Scale 1:20000
0 ¼ ½ ¾ 1
0 1000 2000 3000 4000 5000



CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 22

Land division corners are approximately positioned on this map.

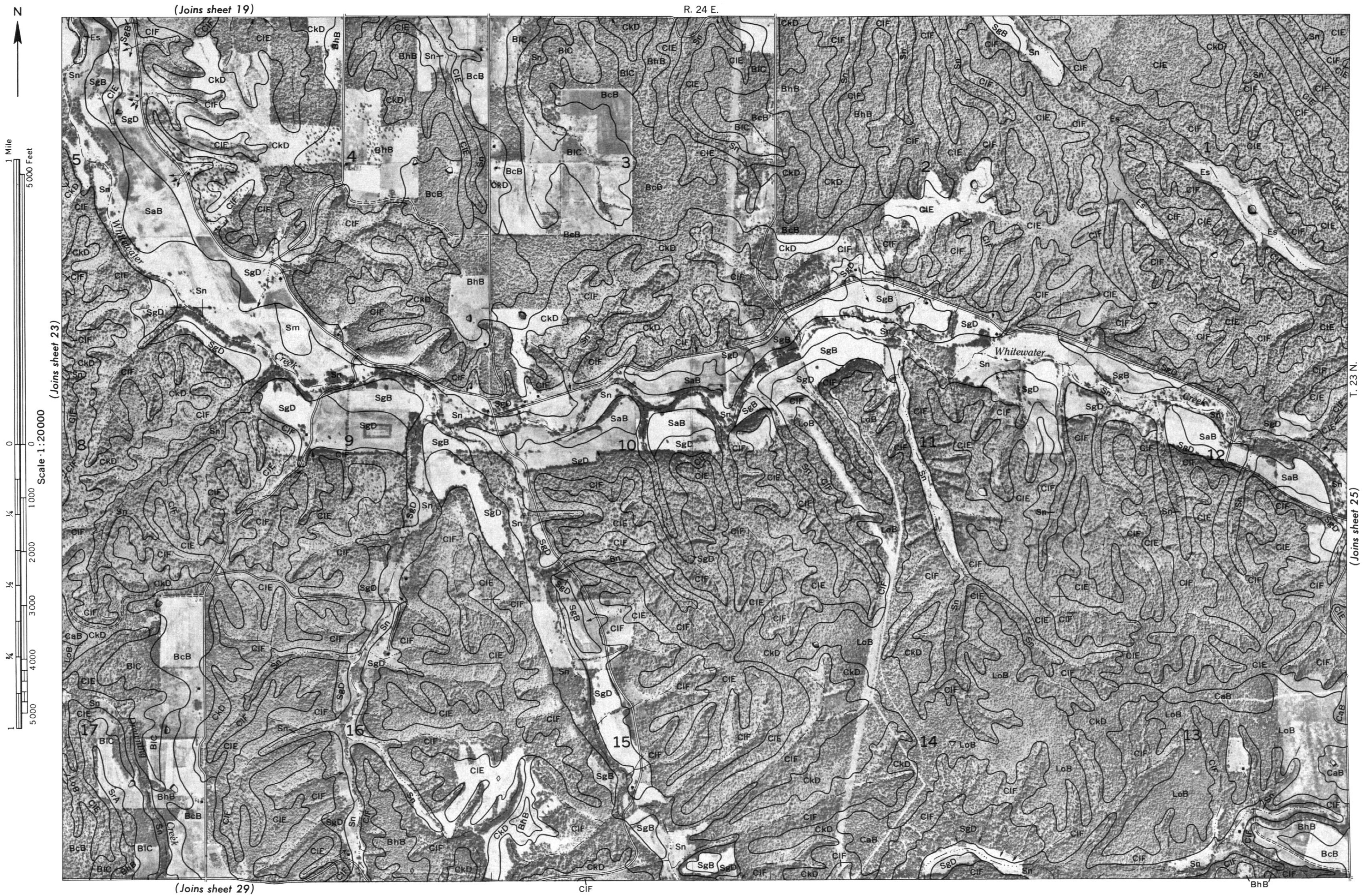
This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.



This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 23

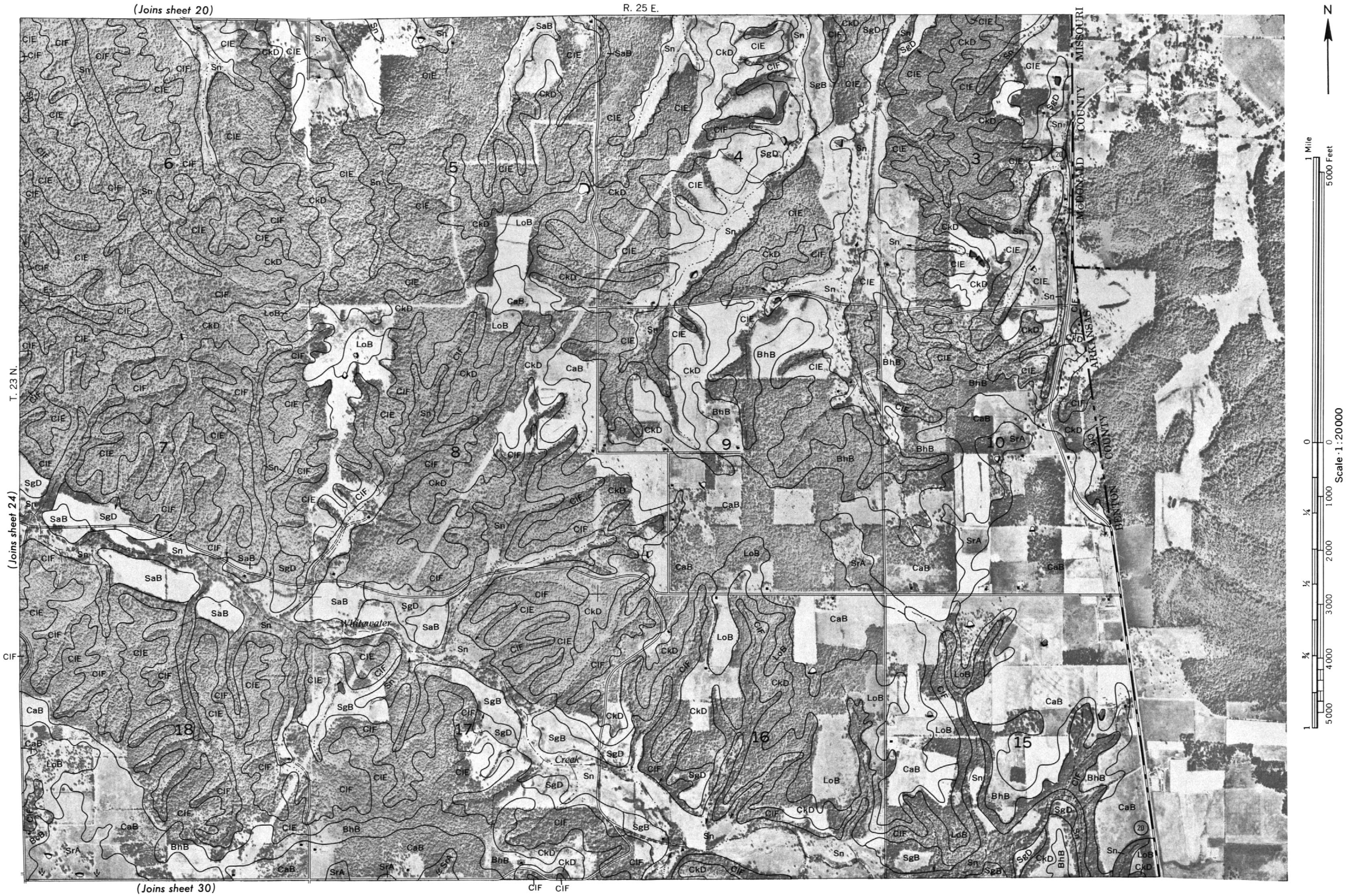
CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 24



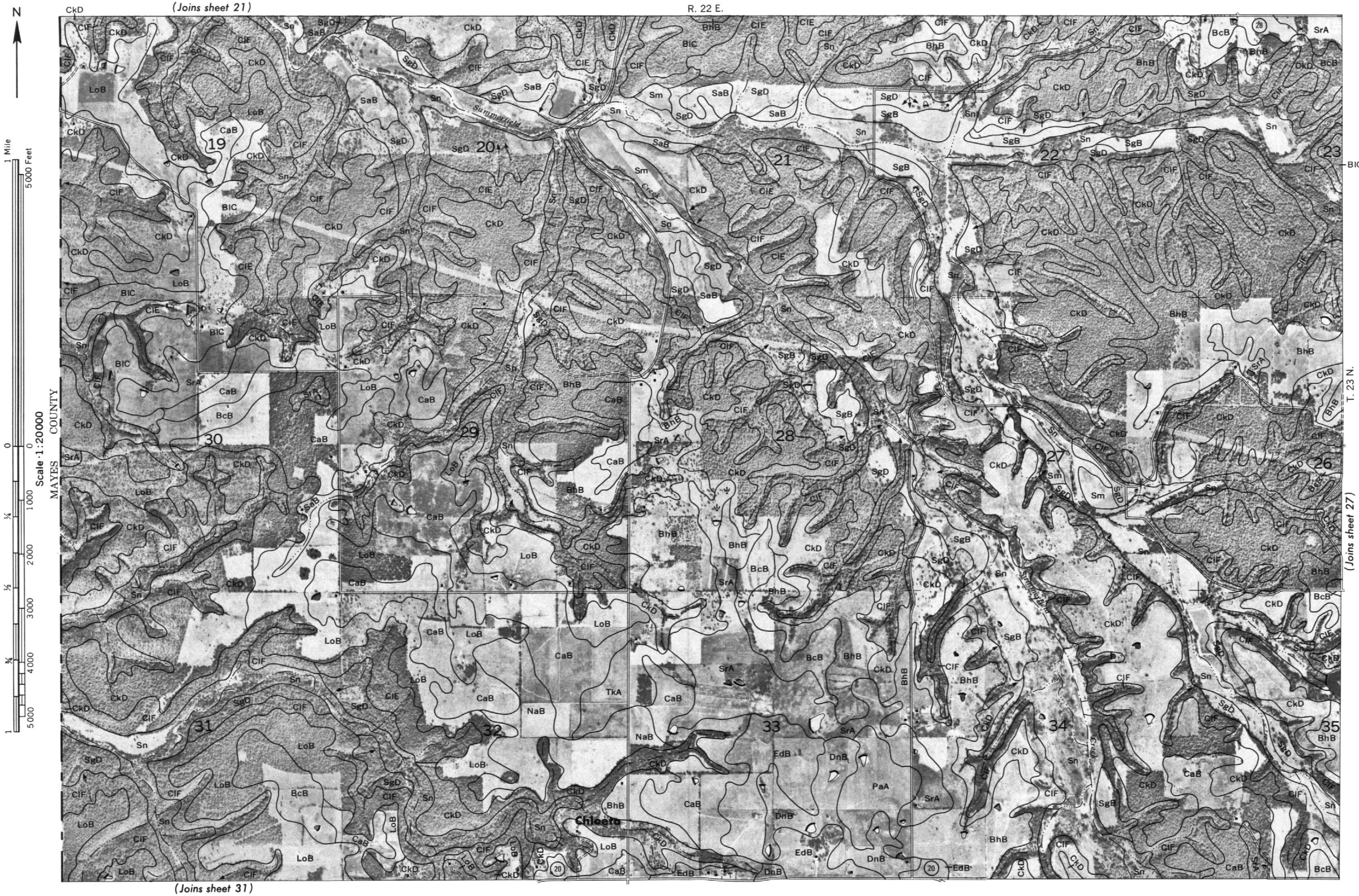
CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 24

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.



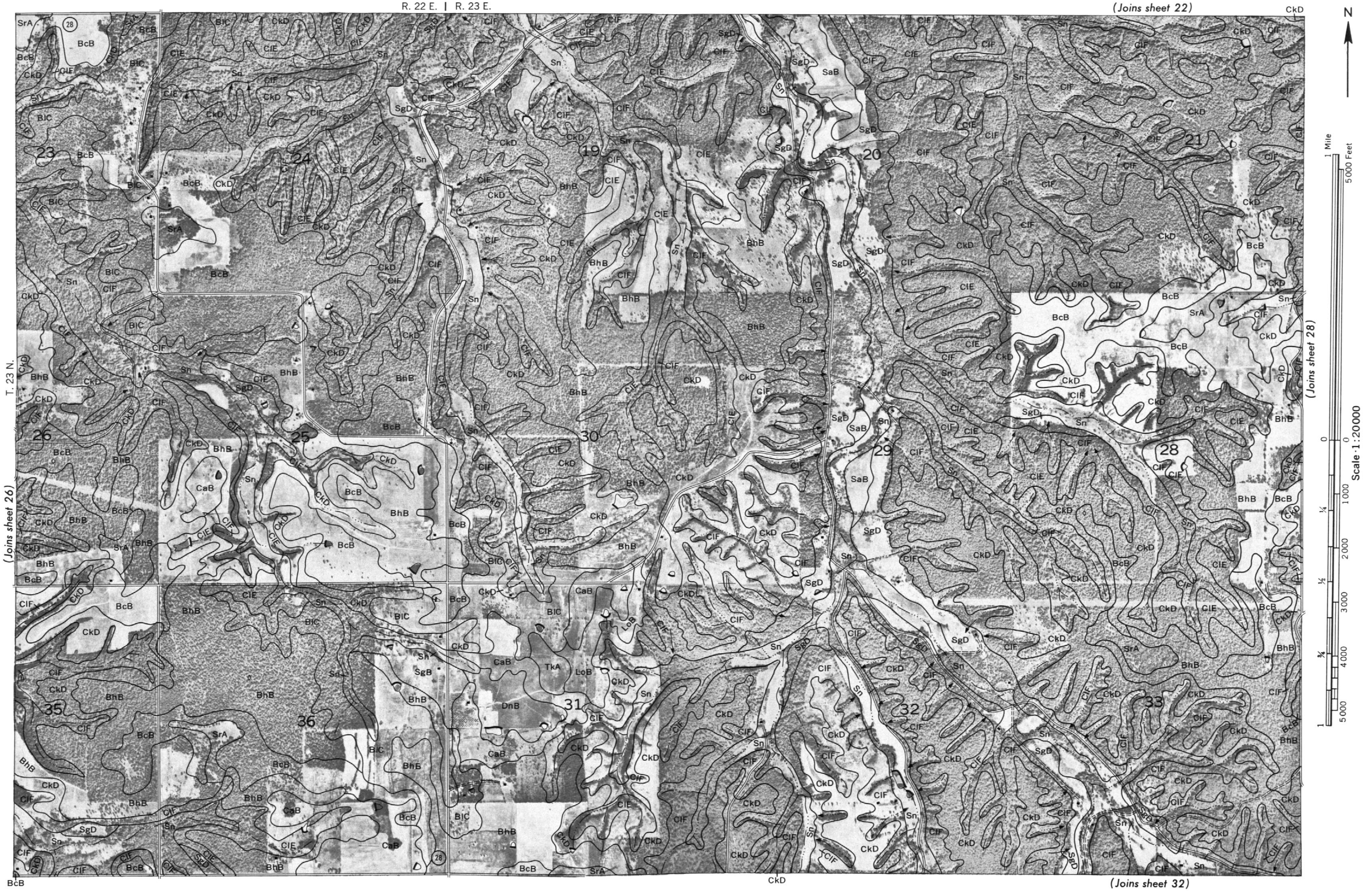
This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Land division corners are approximately positioned on this map.



CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 26

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

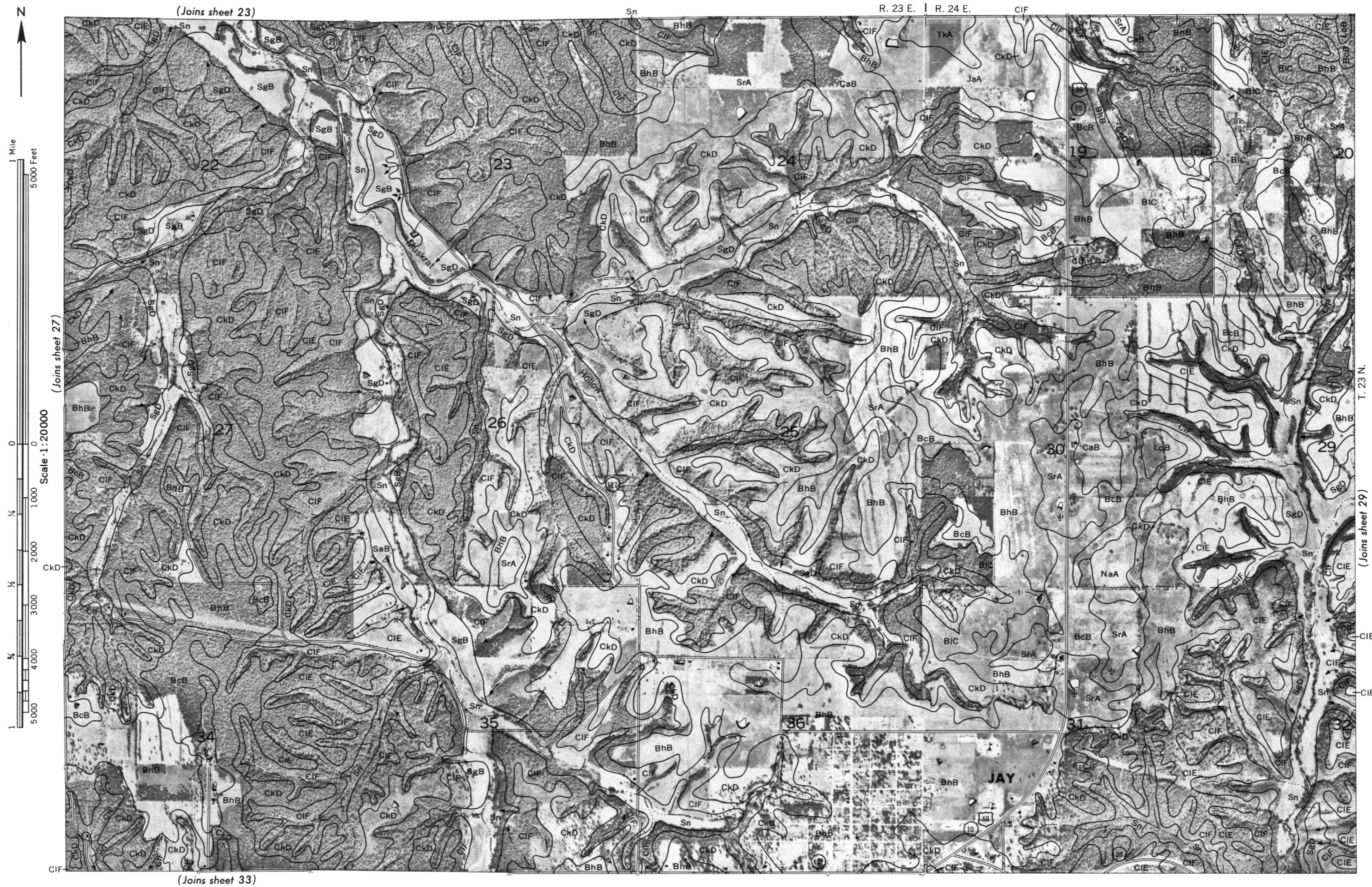


This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 27

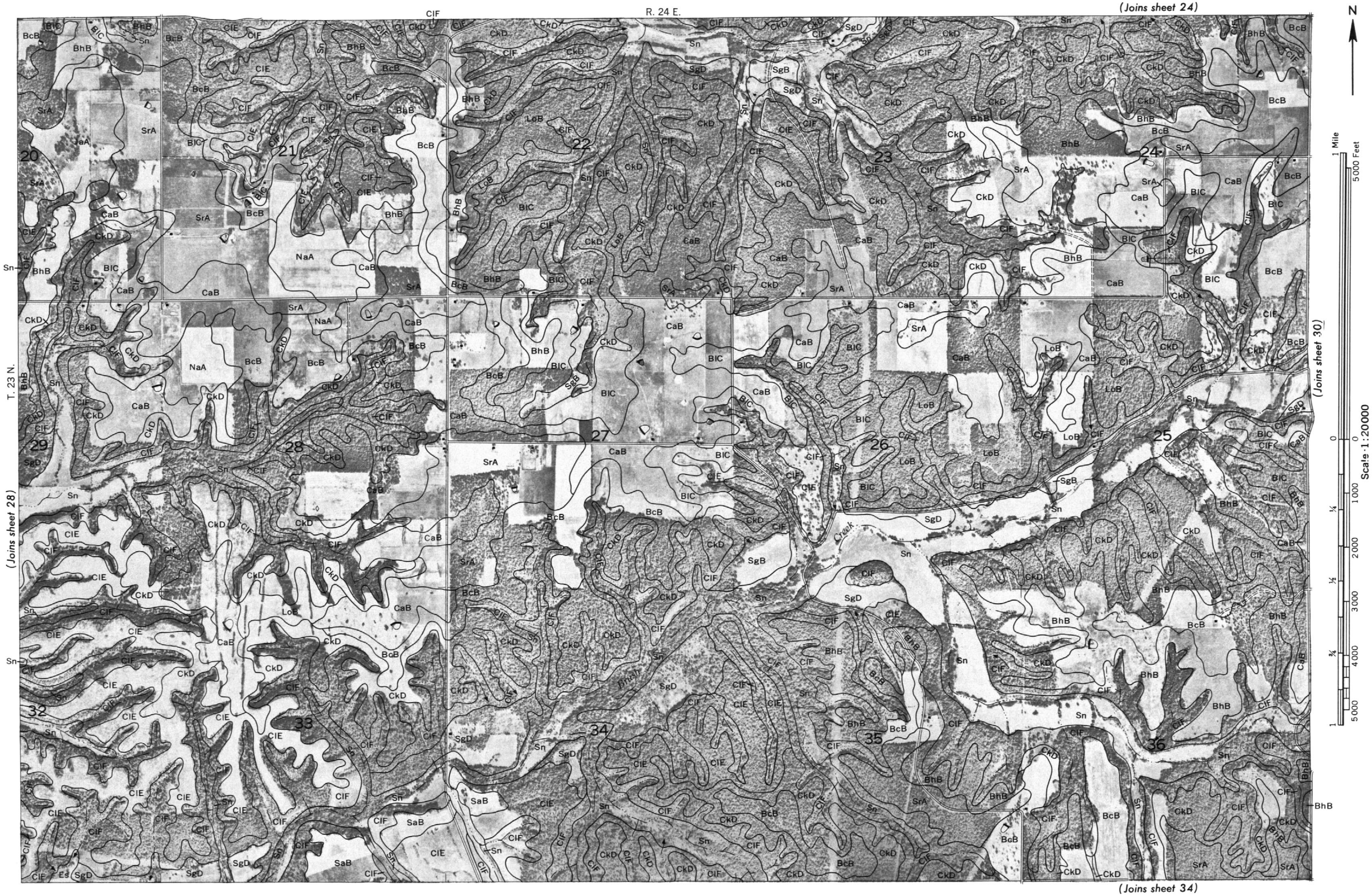
CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 28



CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 28

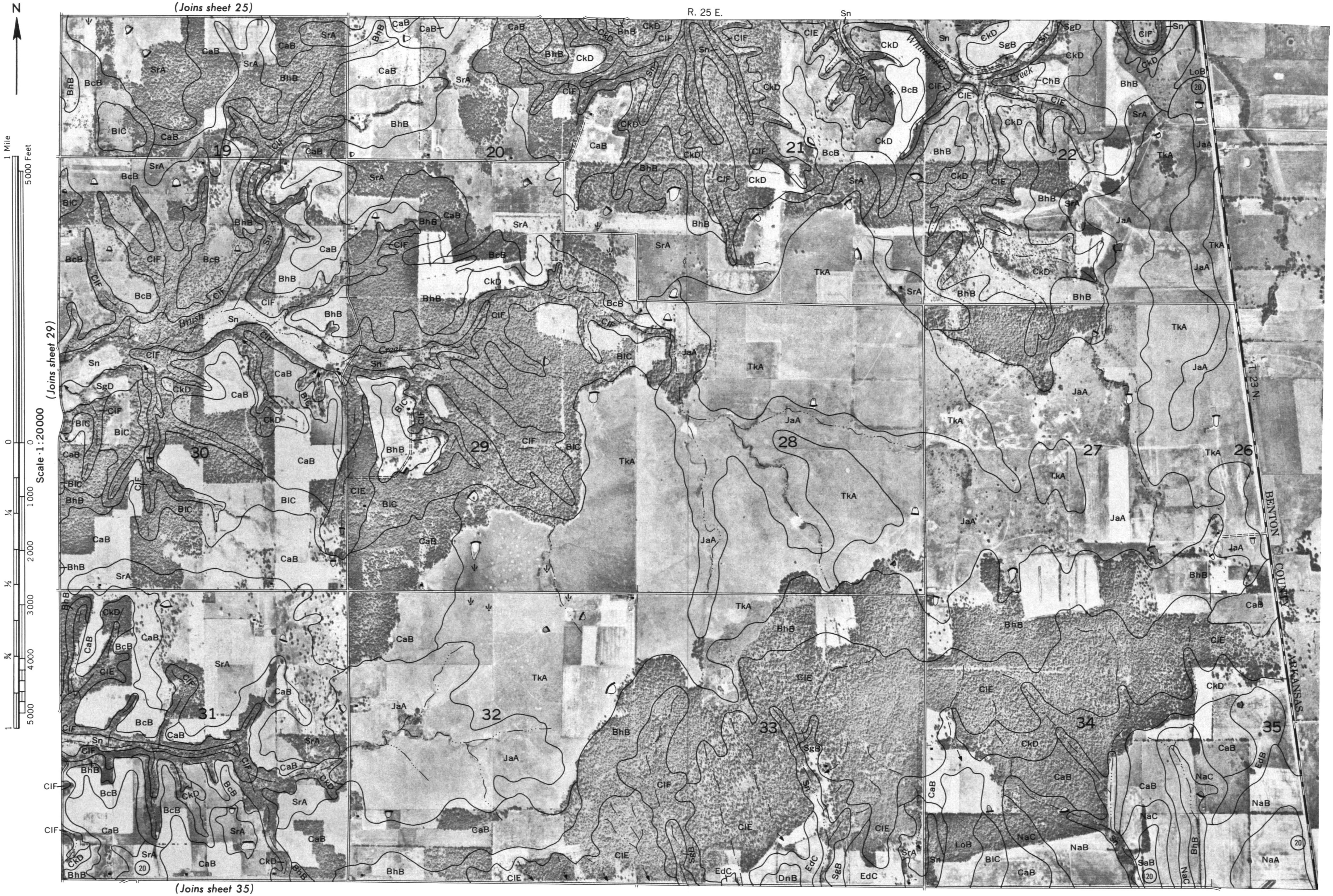
Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.



This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 30



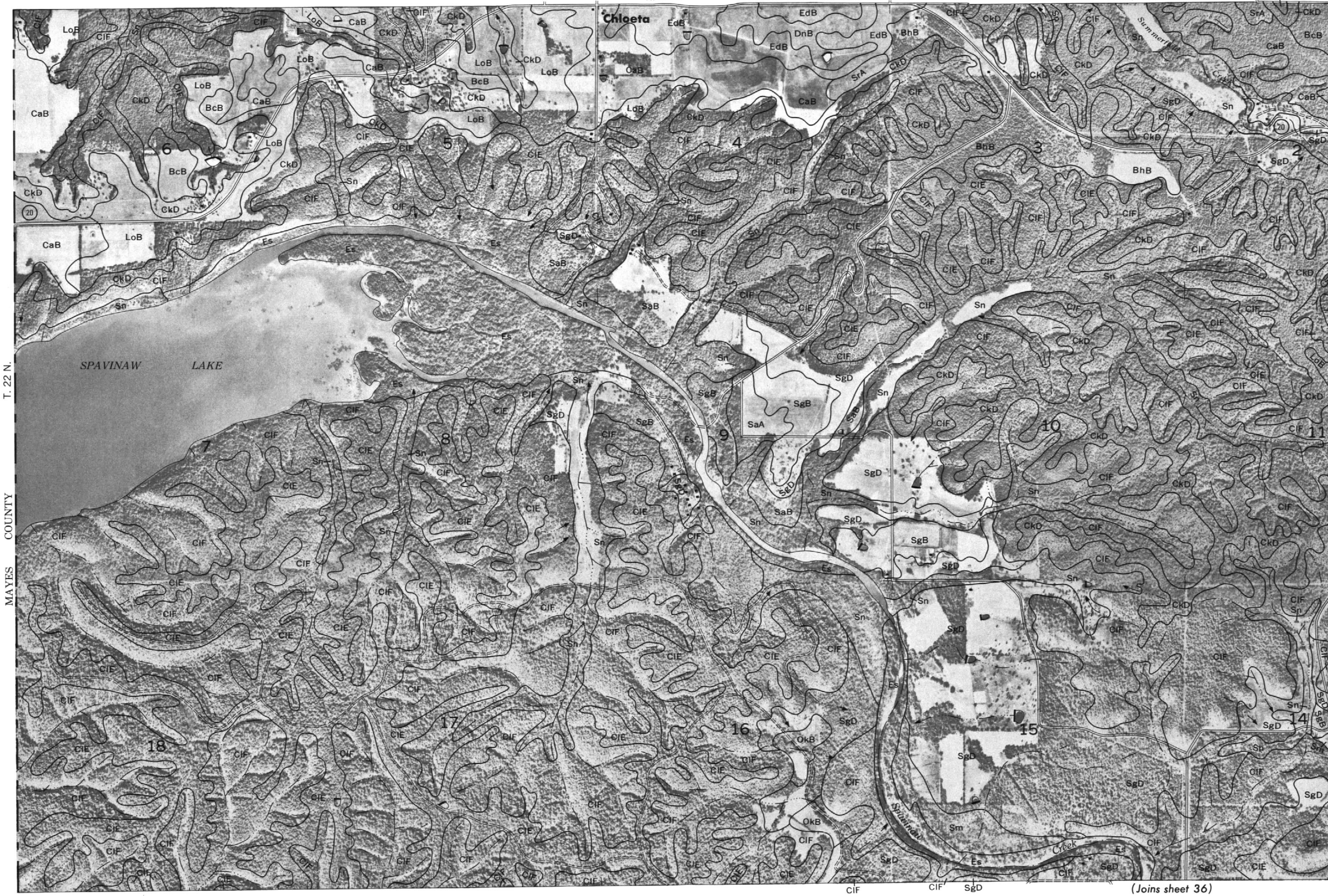
CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 30

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

R. 22 E.

(Joins sheet 26)



T. 22 N.

MAYES COUNTY

(Joins sheet 32)

(Joins sheet 36)

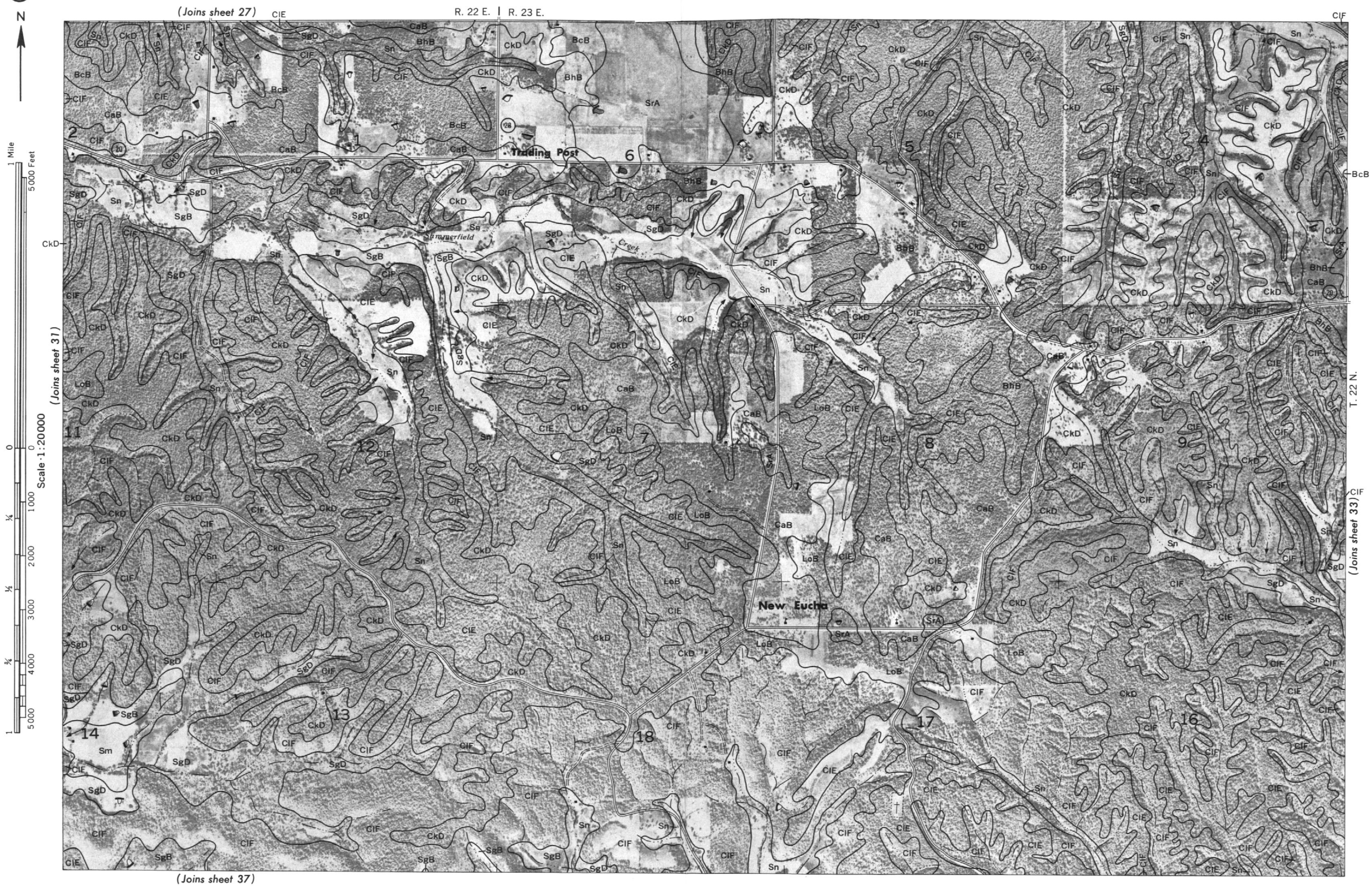
N

1 Mile
5000 Feet
Scale 1:20000

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 31



CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 32

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 34

Land division corners are approximately positioned on this map.

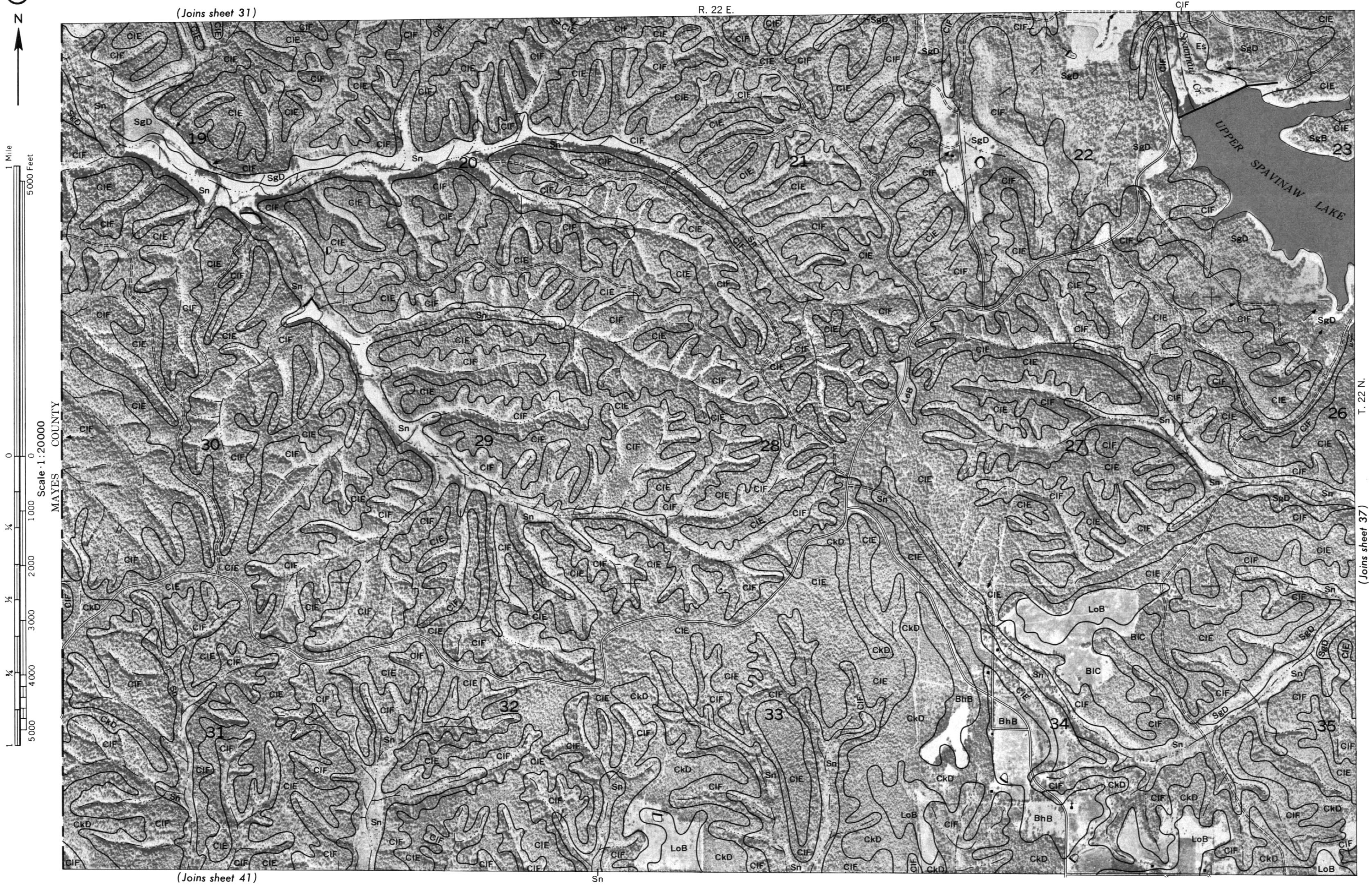
This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 35

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 36

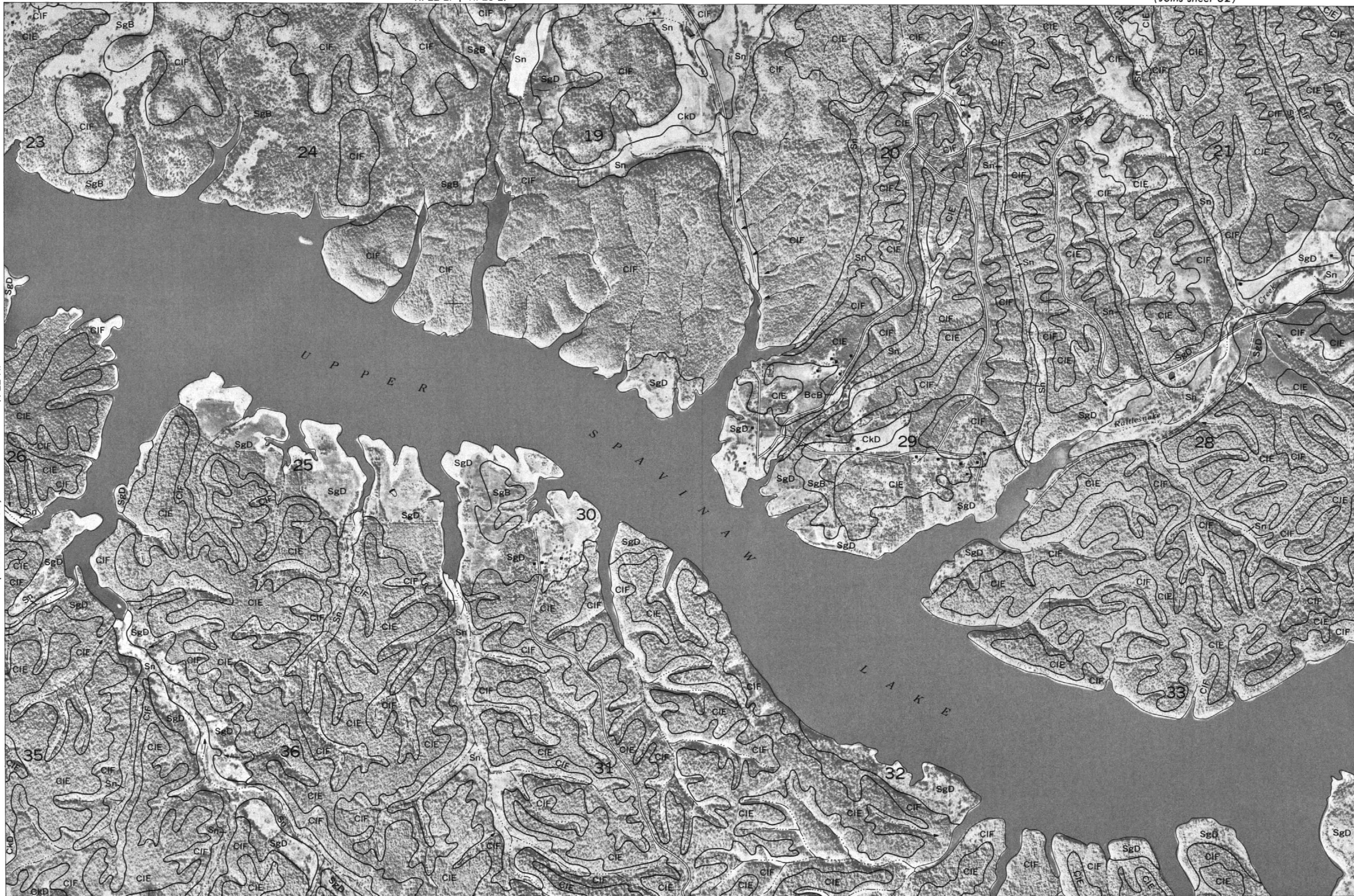


Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

R. 22 E. | R. 23 E.

(Joins sheet 32)



T. 22 N.

(Joins sheet 36)

(Joins sheet 38)

(Joins sheet 42)

ClF

N

1 Mile
5000 Feet
0
0
1000
¼
2000
½
3000
¾
4000
1
5000
Scale 1:20000

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 38

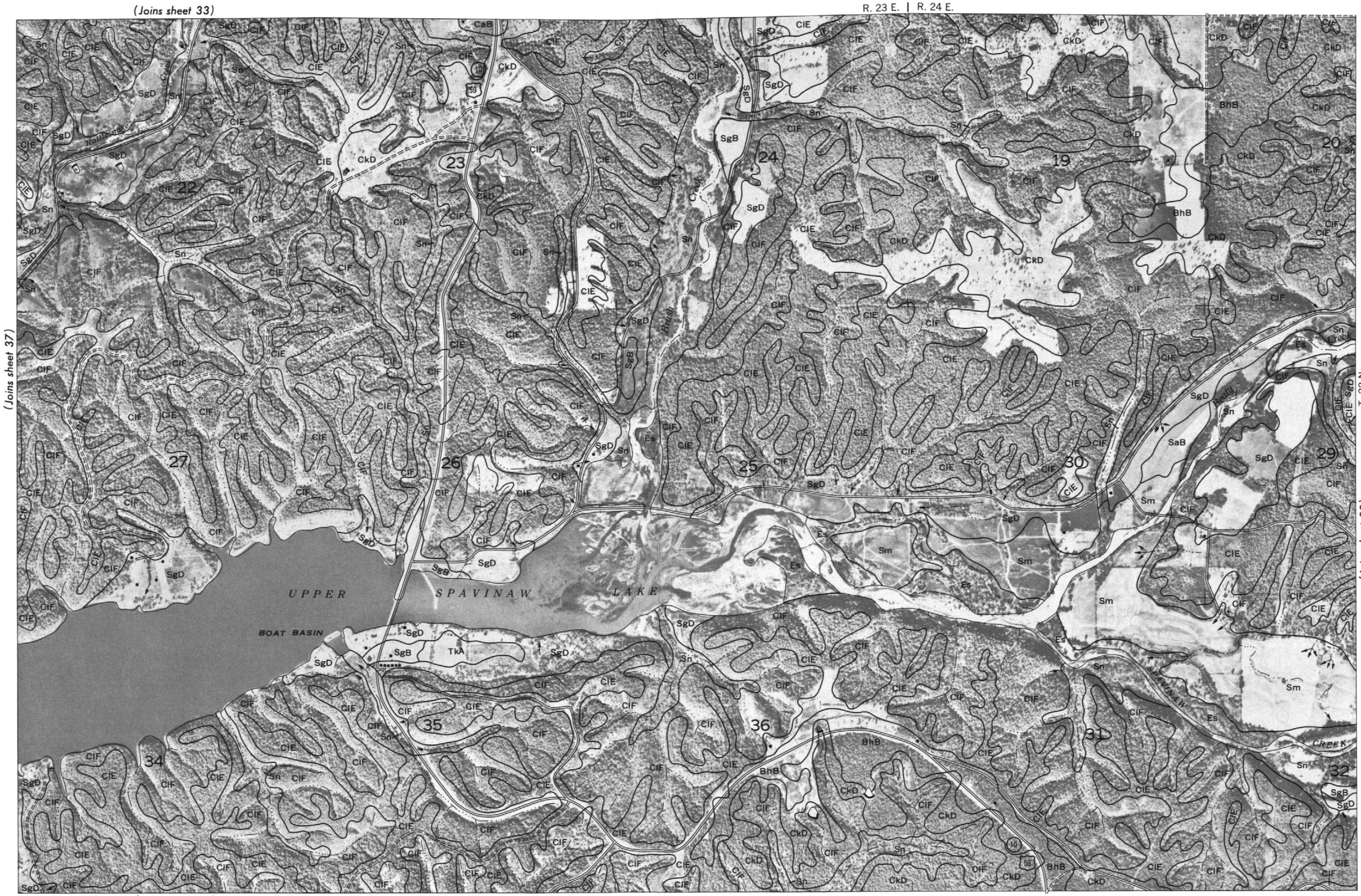
(Joins sheet 33)

R. 23 E. | R. 24 E.

N

1 Mile
5000 Feet
0
Scale 1:20000
1000
¼
2000
½
3000
¾
4000
1
5000

(Joins sheet 37)



T. 22 N.

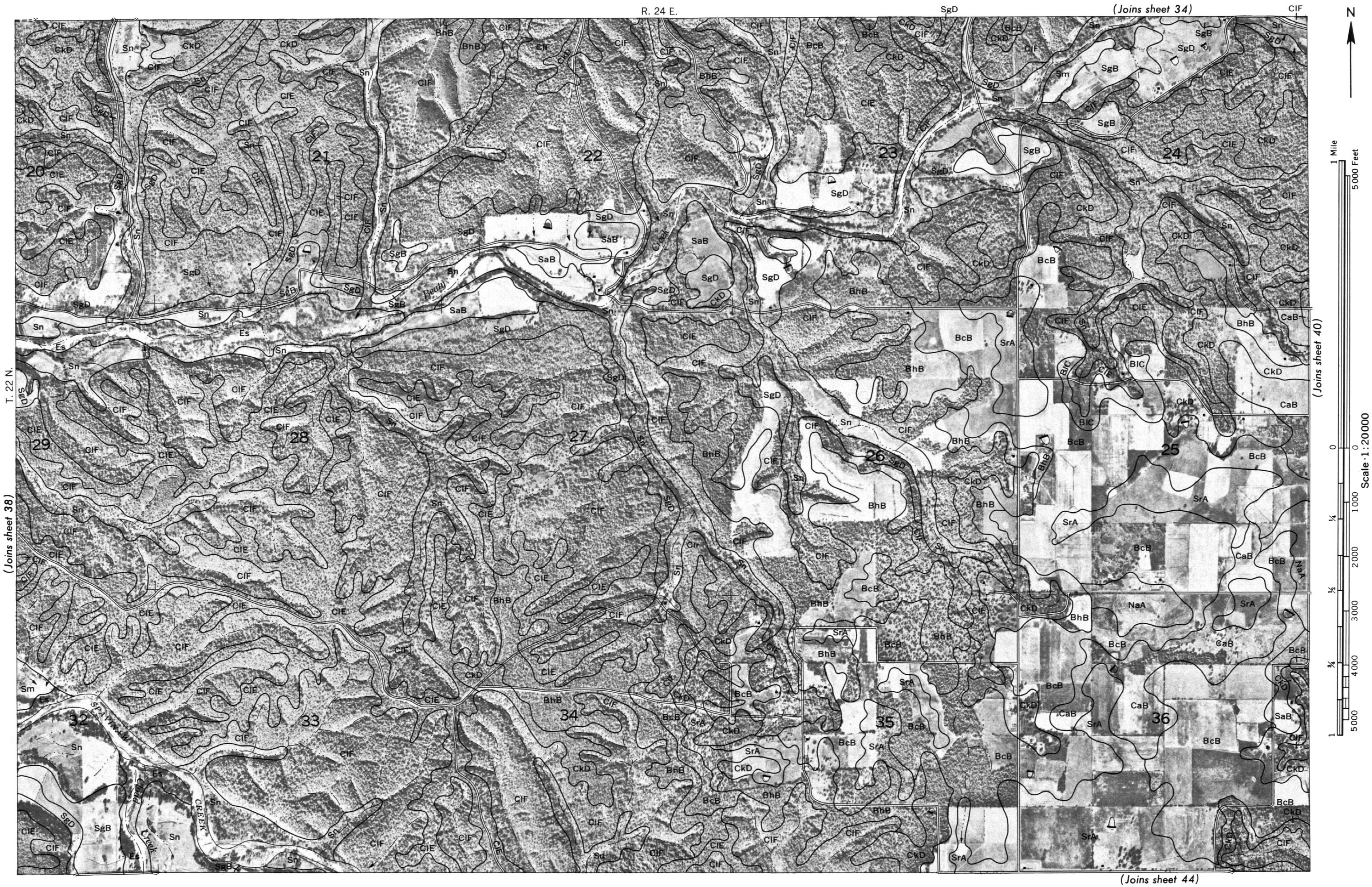
(Joins sheet 39)

(Joins sheet 43)

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 38

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.



This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 39

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 40

N

(Joins sheet 35)

R. 25 E.

(Joins sheet 39)

T. 22 N.

(Joins center inset, sheet 46)

SaB

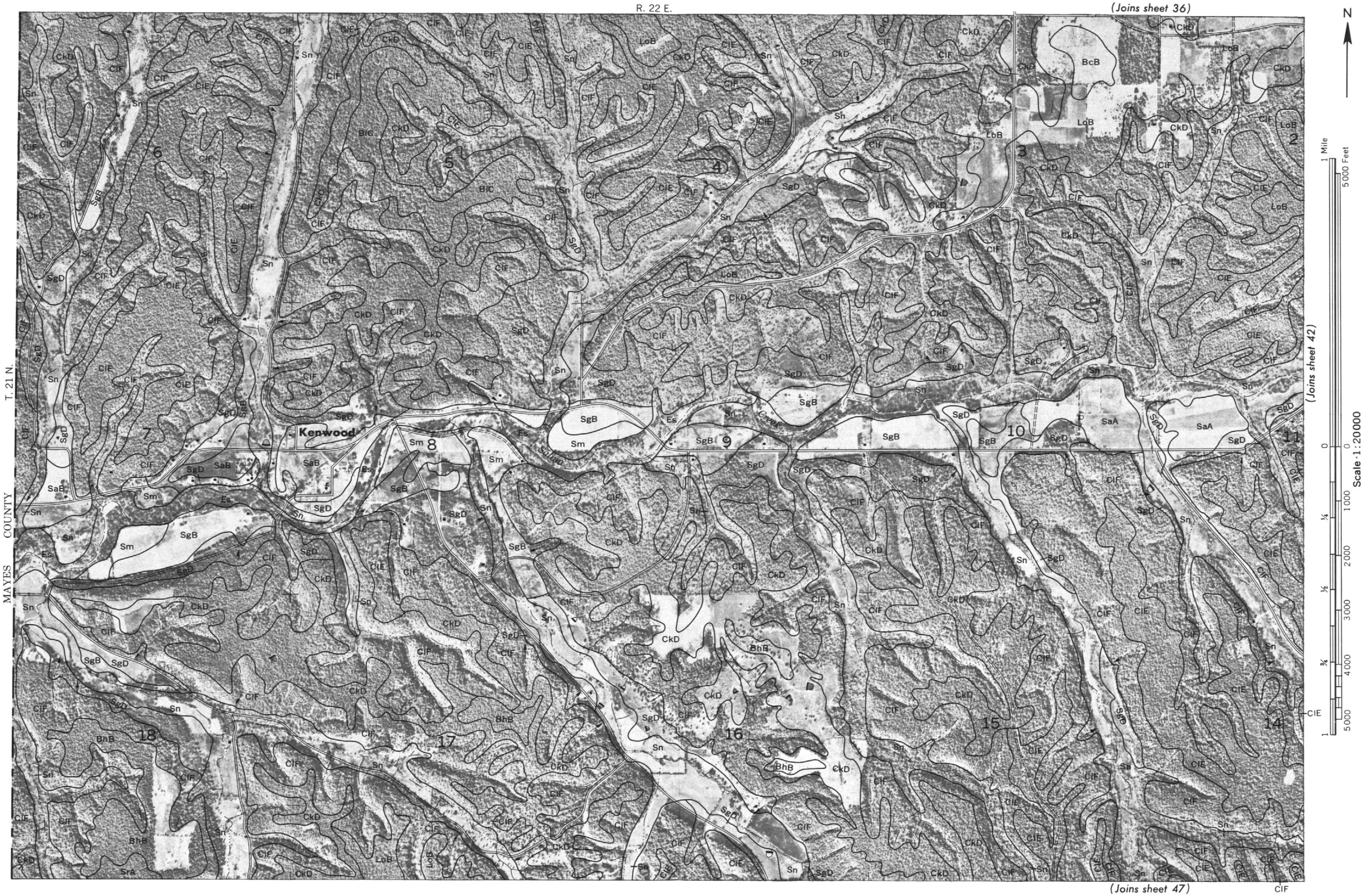
(Joins sheet 45) | (Sheet 46)

1 Mile
5000 Feet
Scale 1:20000
0 1000 2000 3000 4000 5000
0 ¼ ½ ¾ 1

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 40

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.



This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

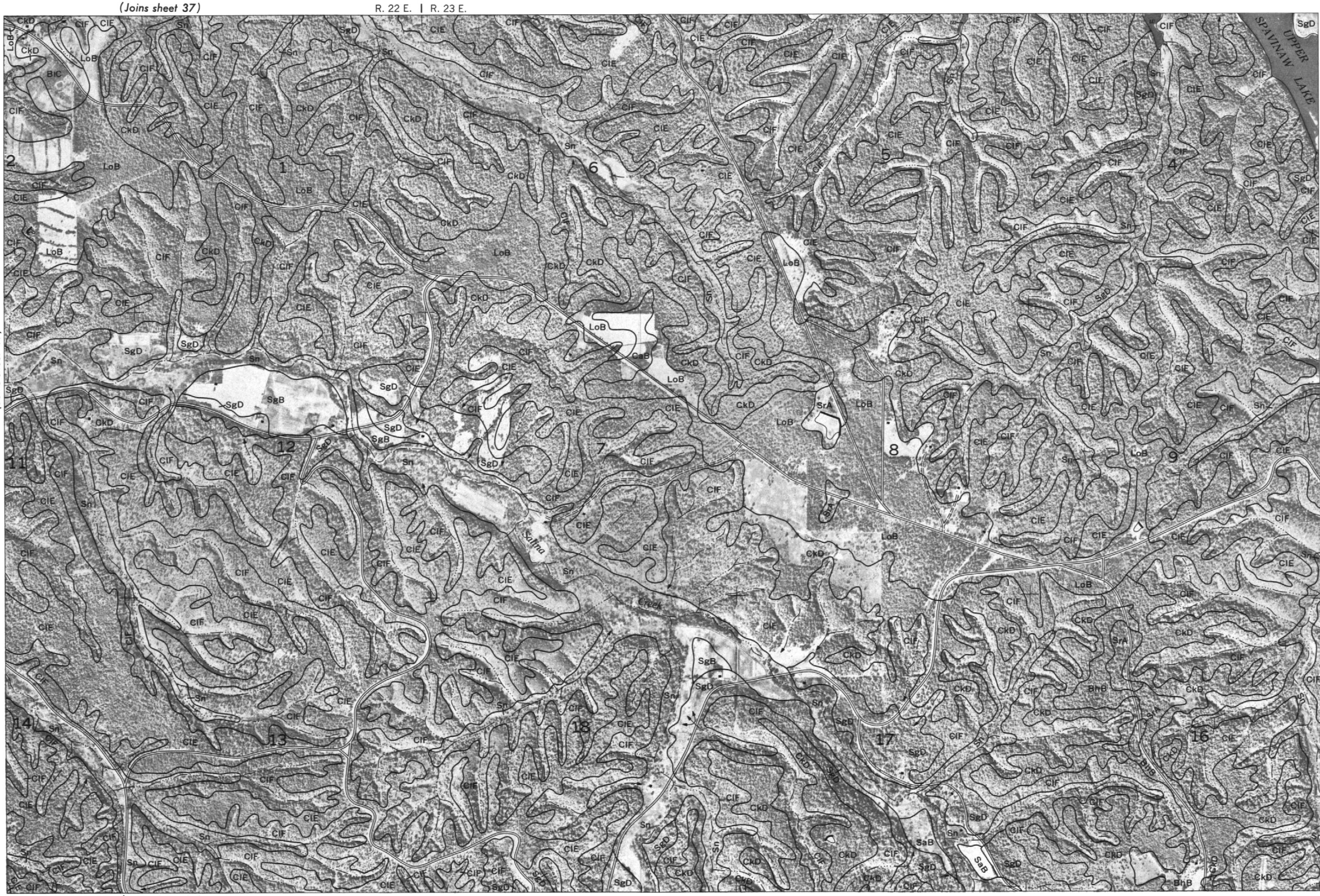
N

1 Mile
5000 Feet

Scale 1:20000

1 ¾ ½ ¼ 0

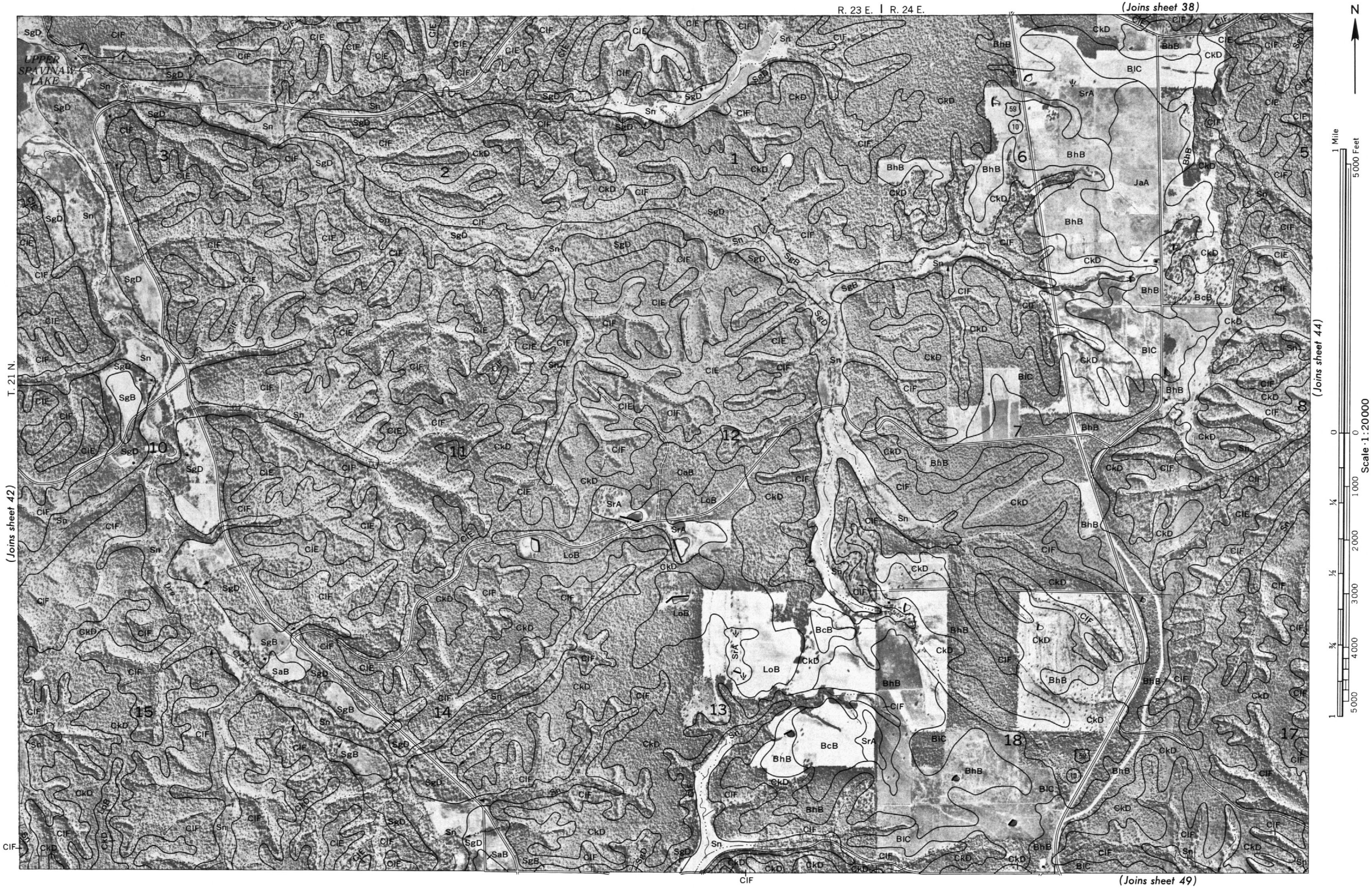
5000 4000 3000 2000 1000 0



CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 42

Land division corners are approximately positioned on this map.

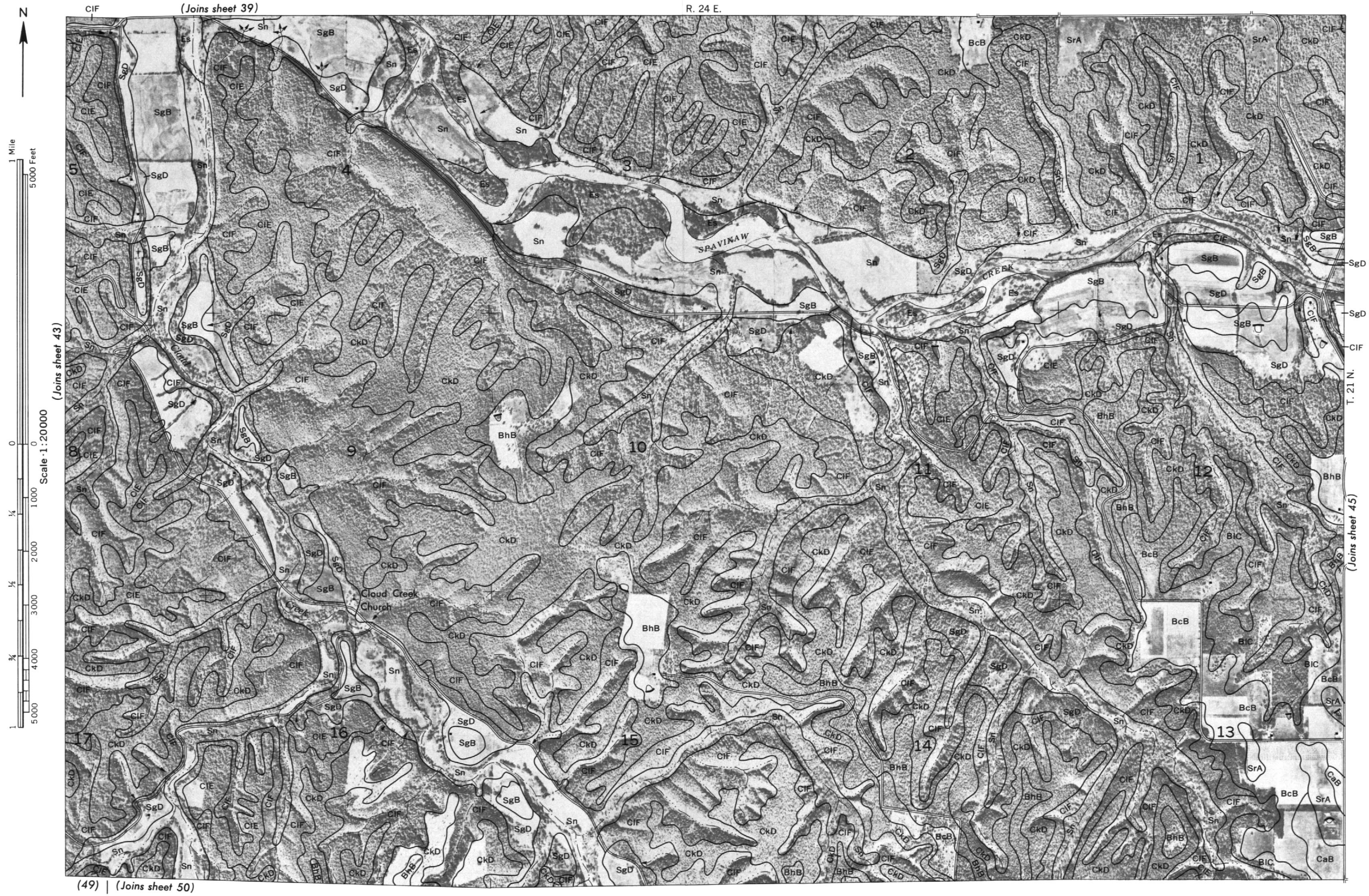
This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.



This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

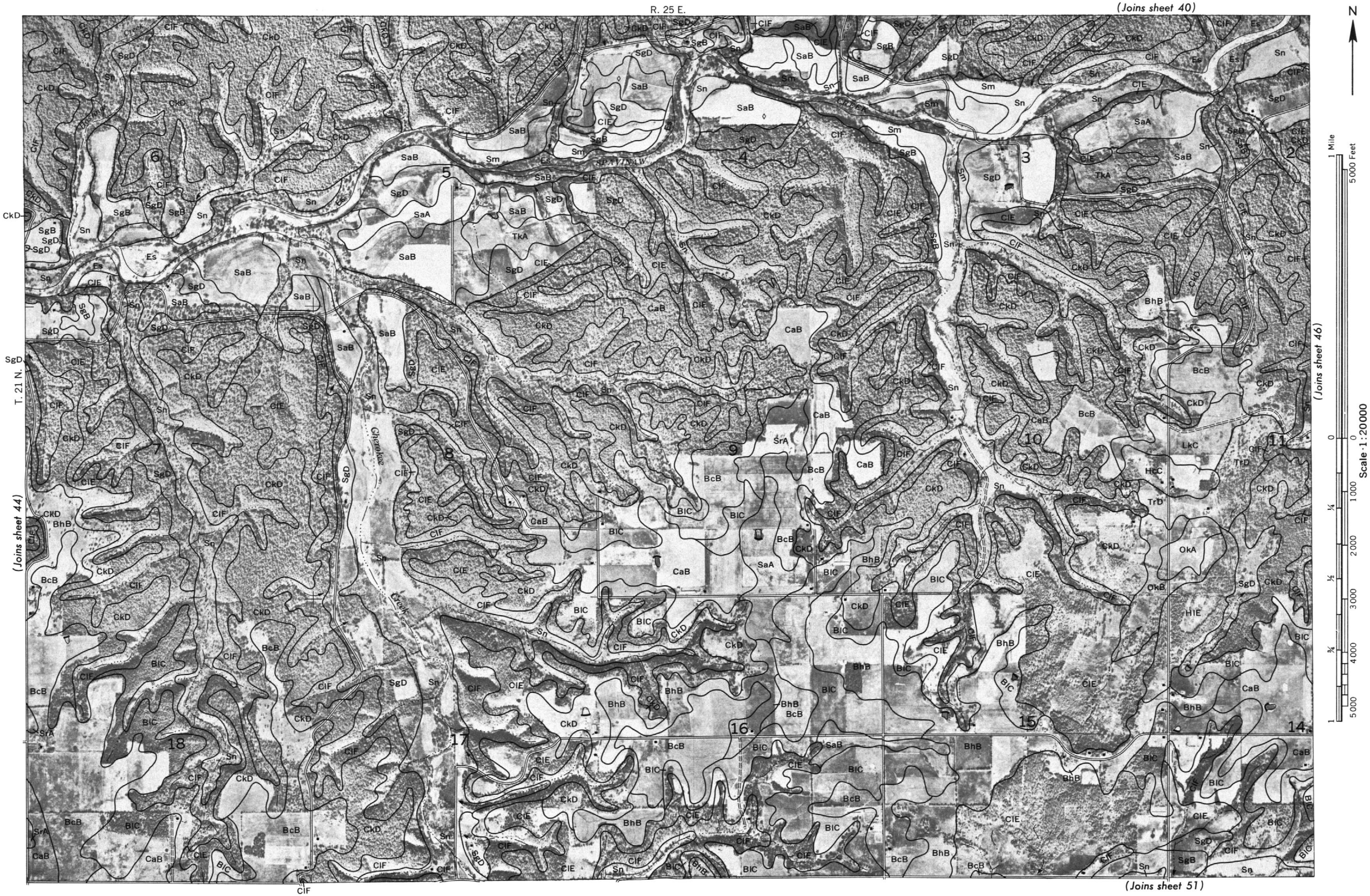
CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 43



CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 44

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

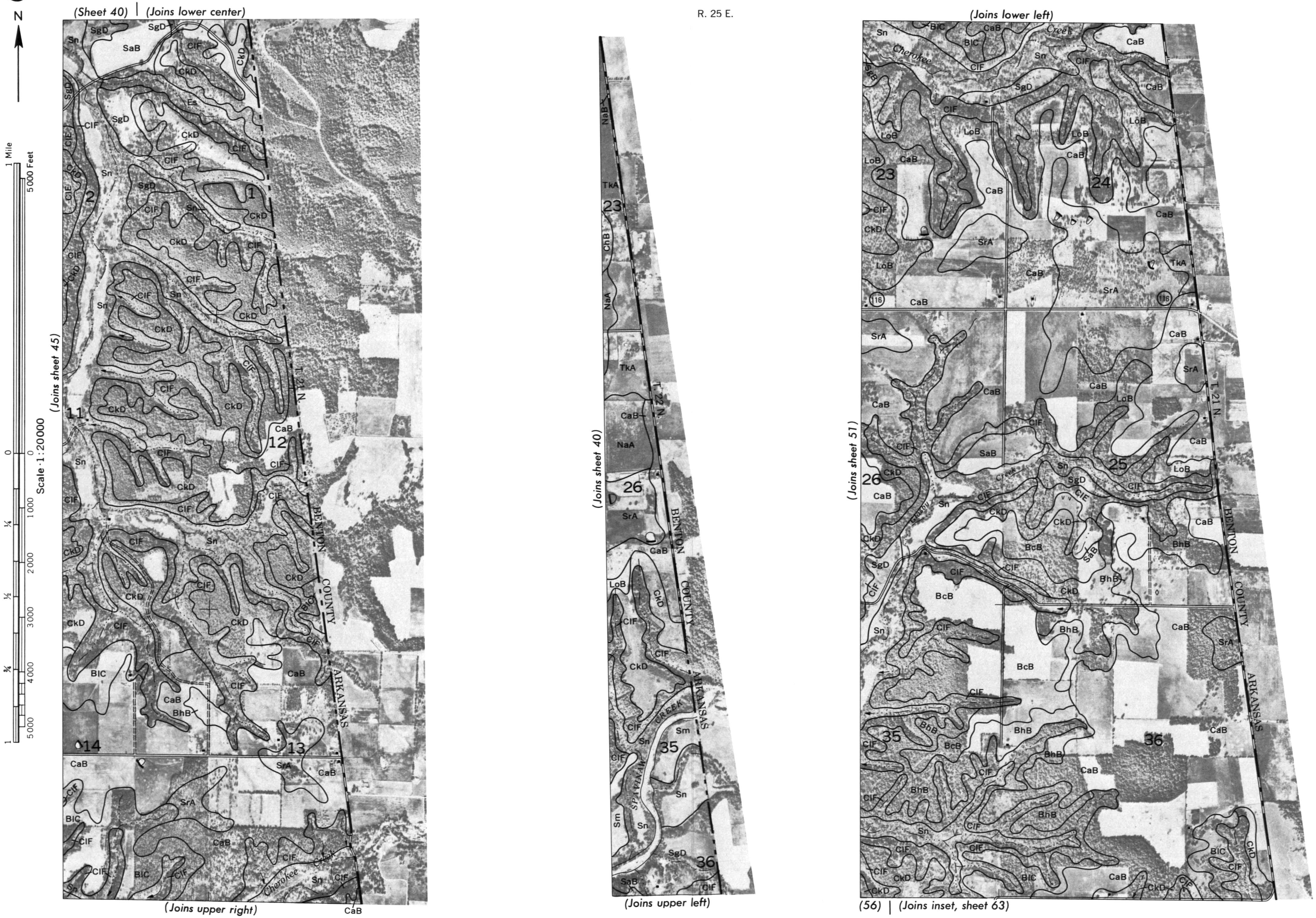


This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 45

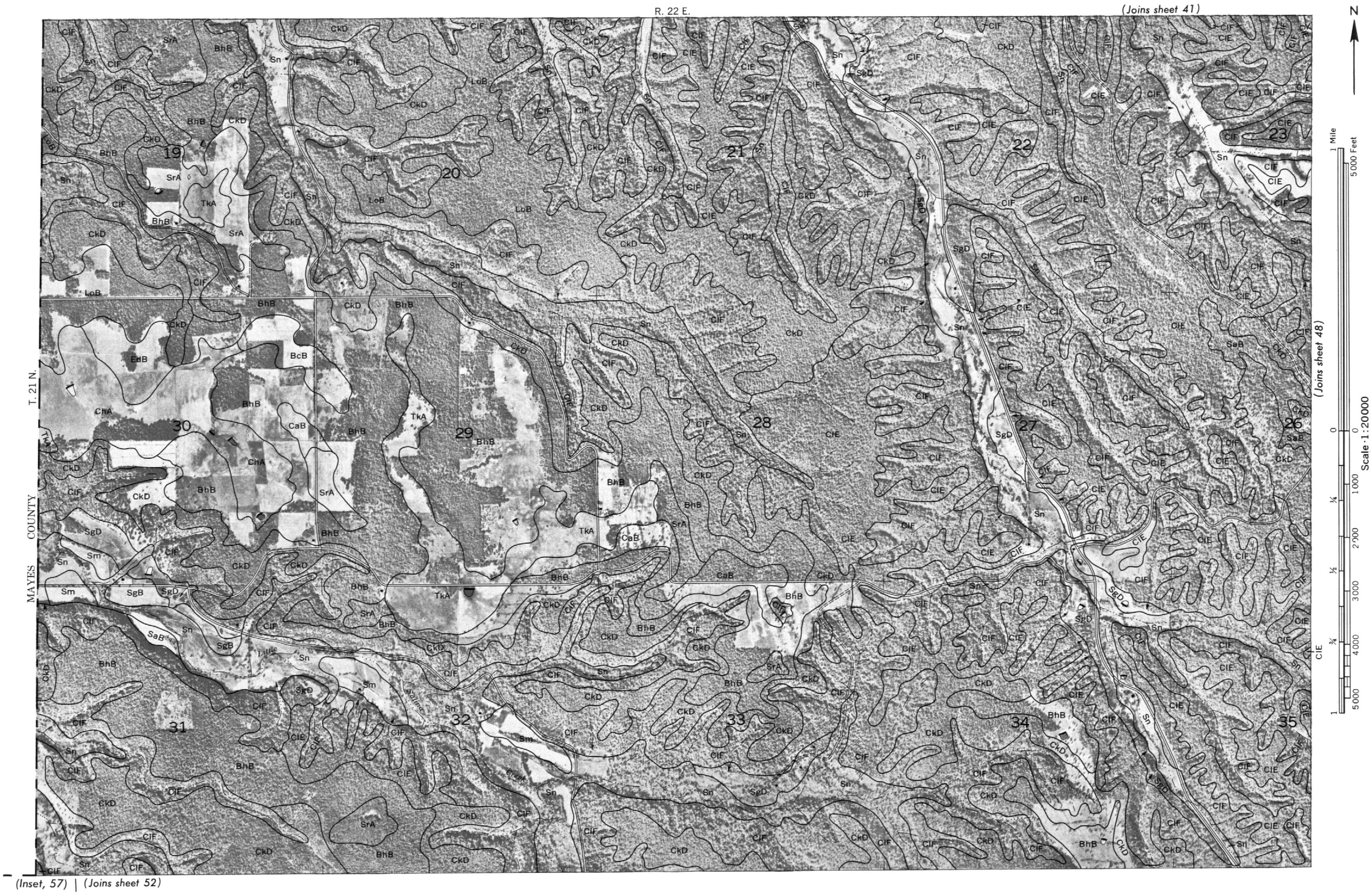
CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 46



CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 46

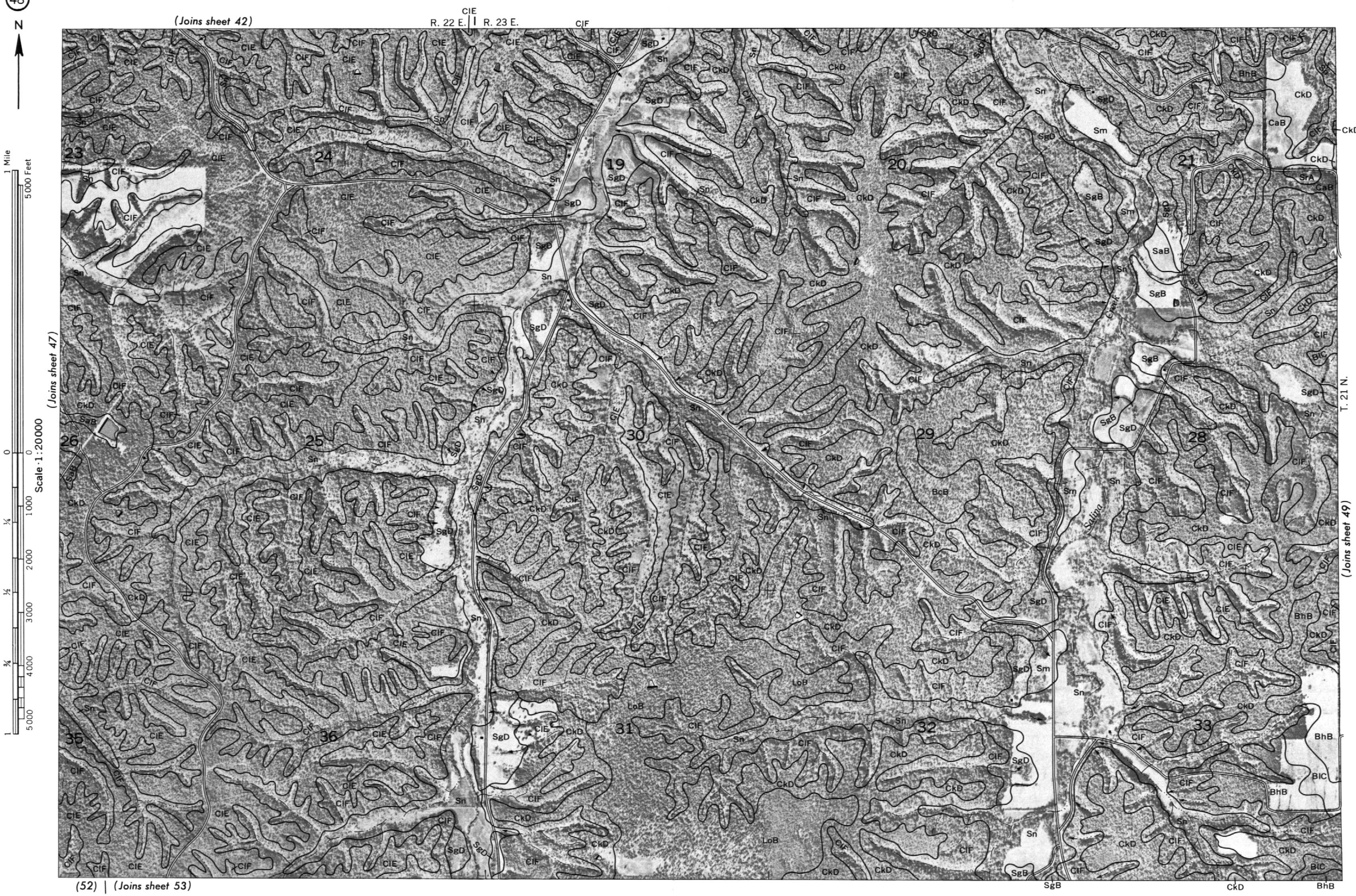
Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.



This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 47



CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 48

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

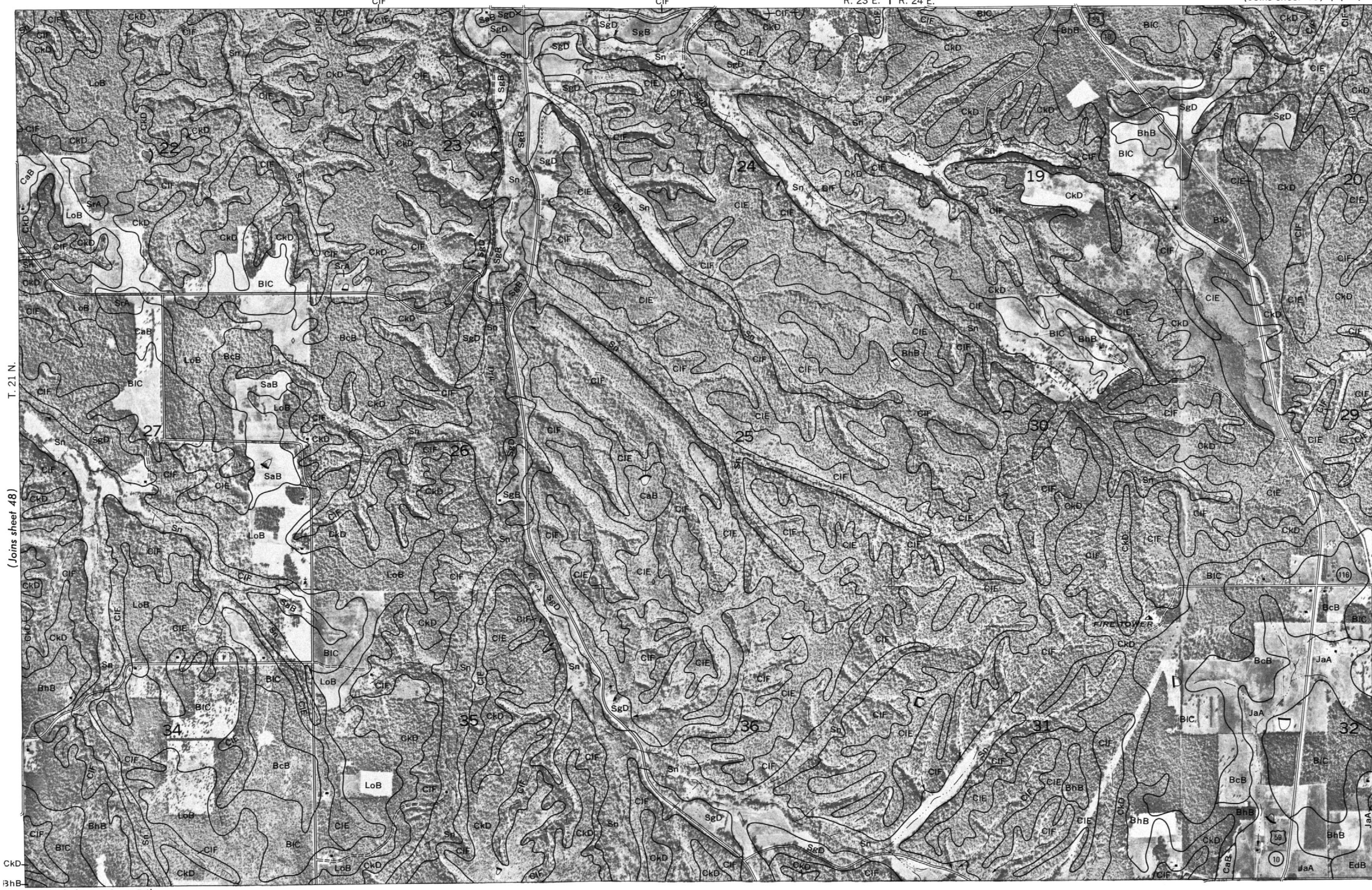
R. 23 E. | R. 24 E.

(Joins sheet 43) | (44)

T. 21 N.

(Joins sheet 48)

(Joins sheet 50)



(53) | (Joins sheet 54)

N

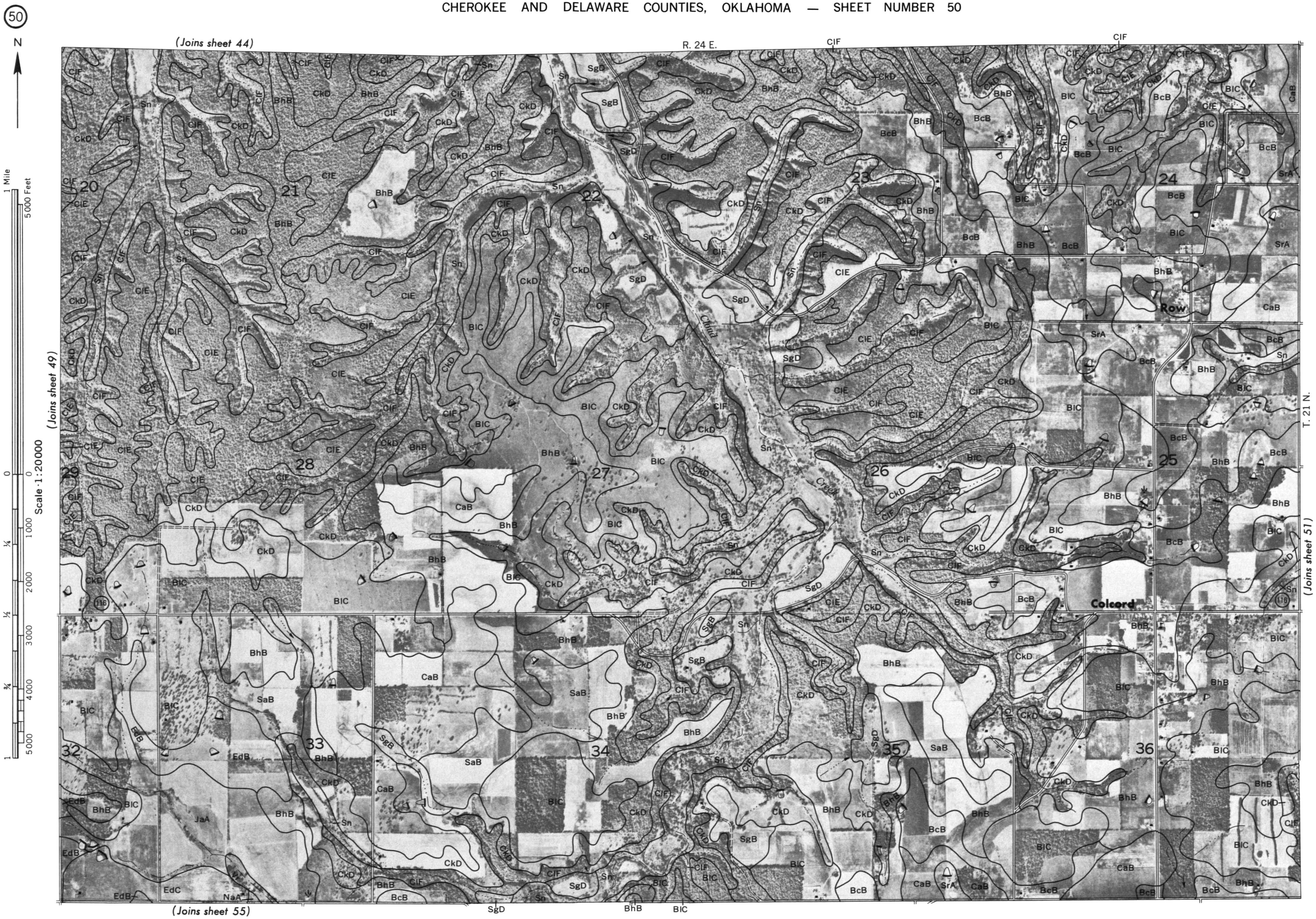
Scale 1:20000

1 Mile
¾
½
¼
0
1

5000 Feet
4000
3000
2000
1000
0
5000

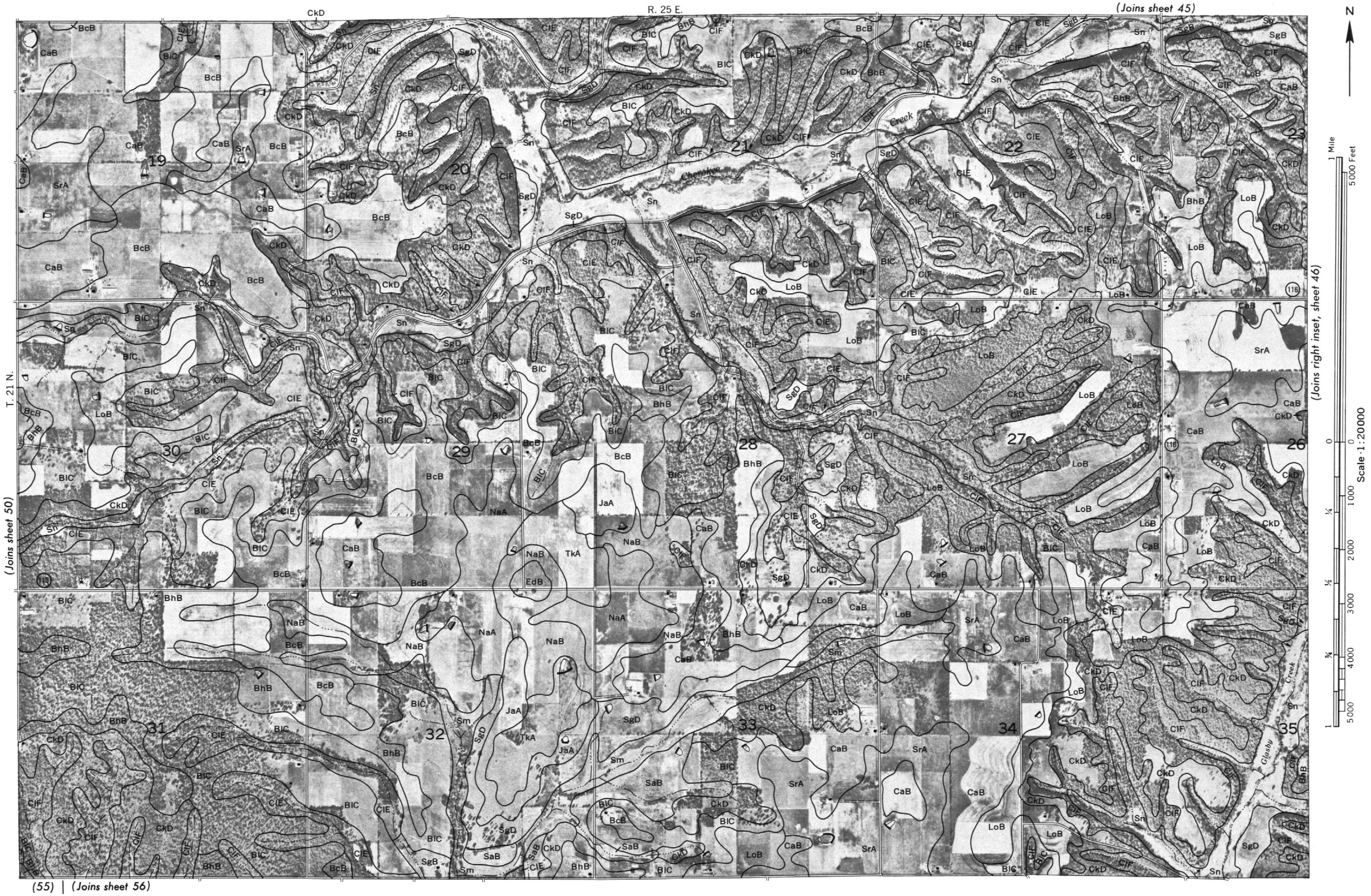
This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 49



Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.



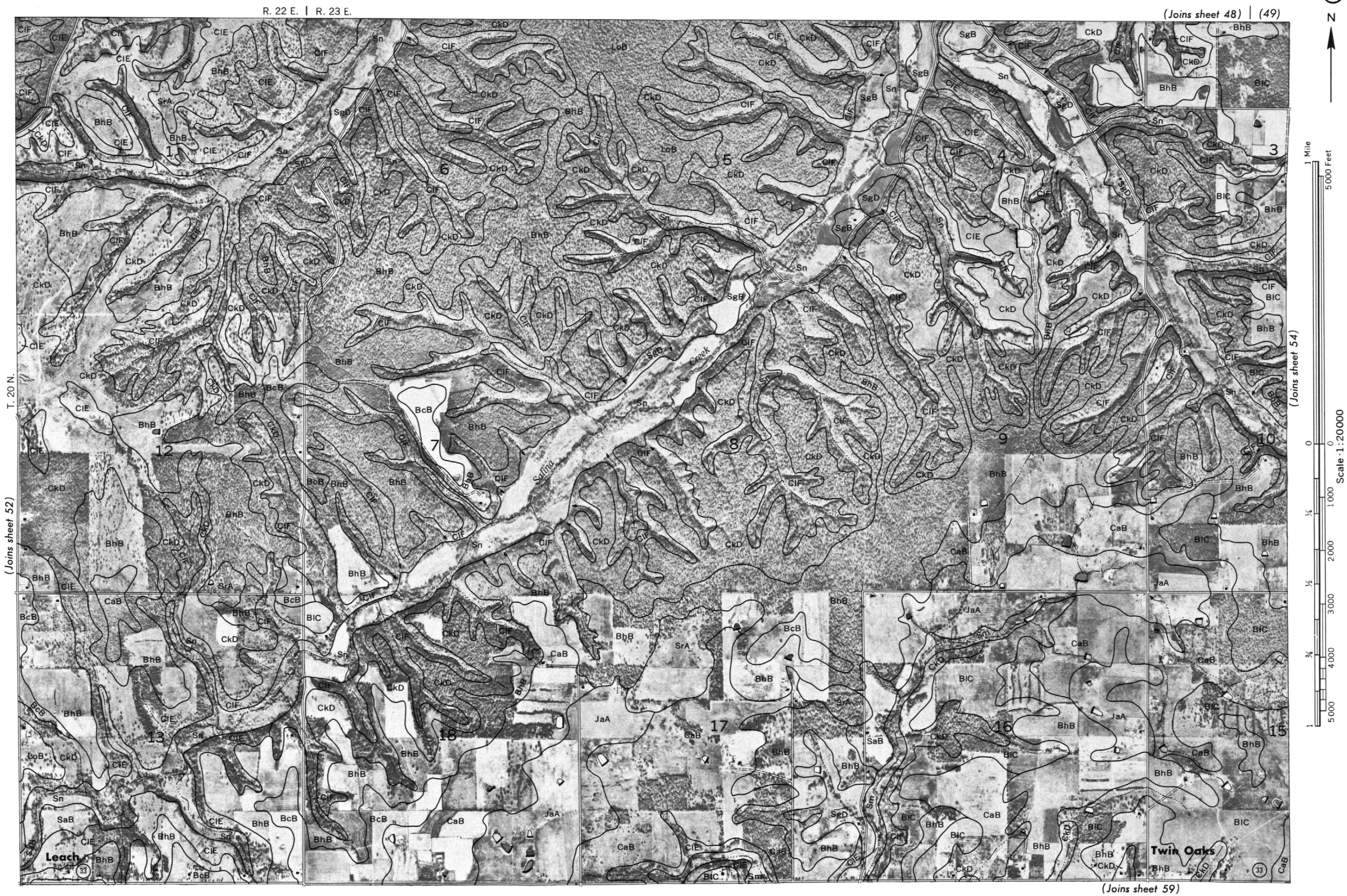
This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 52

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 52

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.



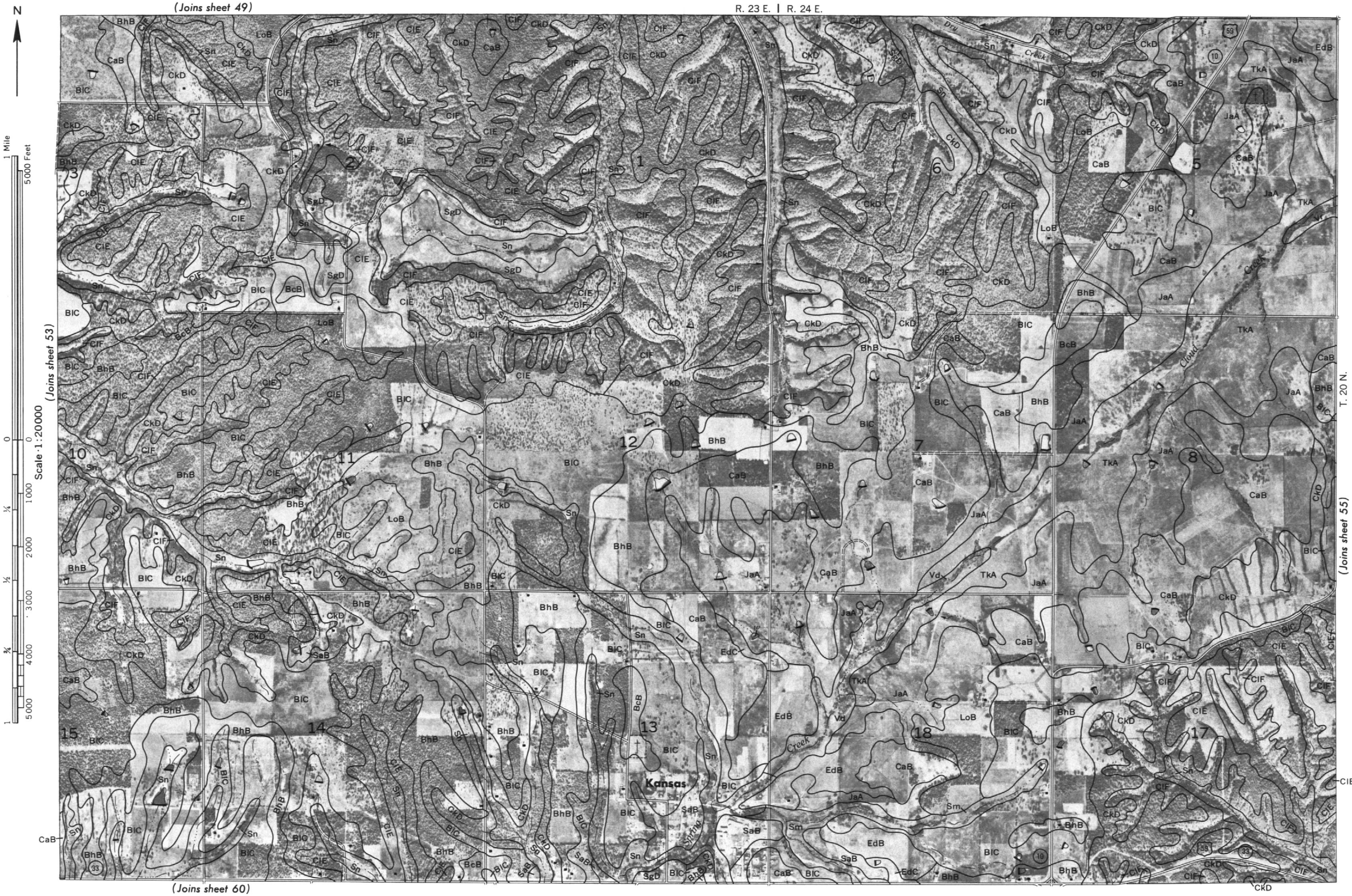
CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 53

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

54

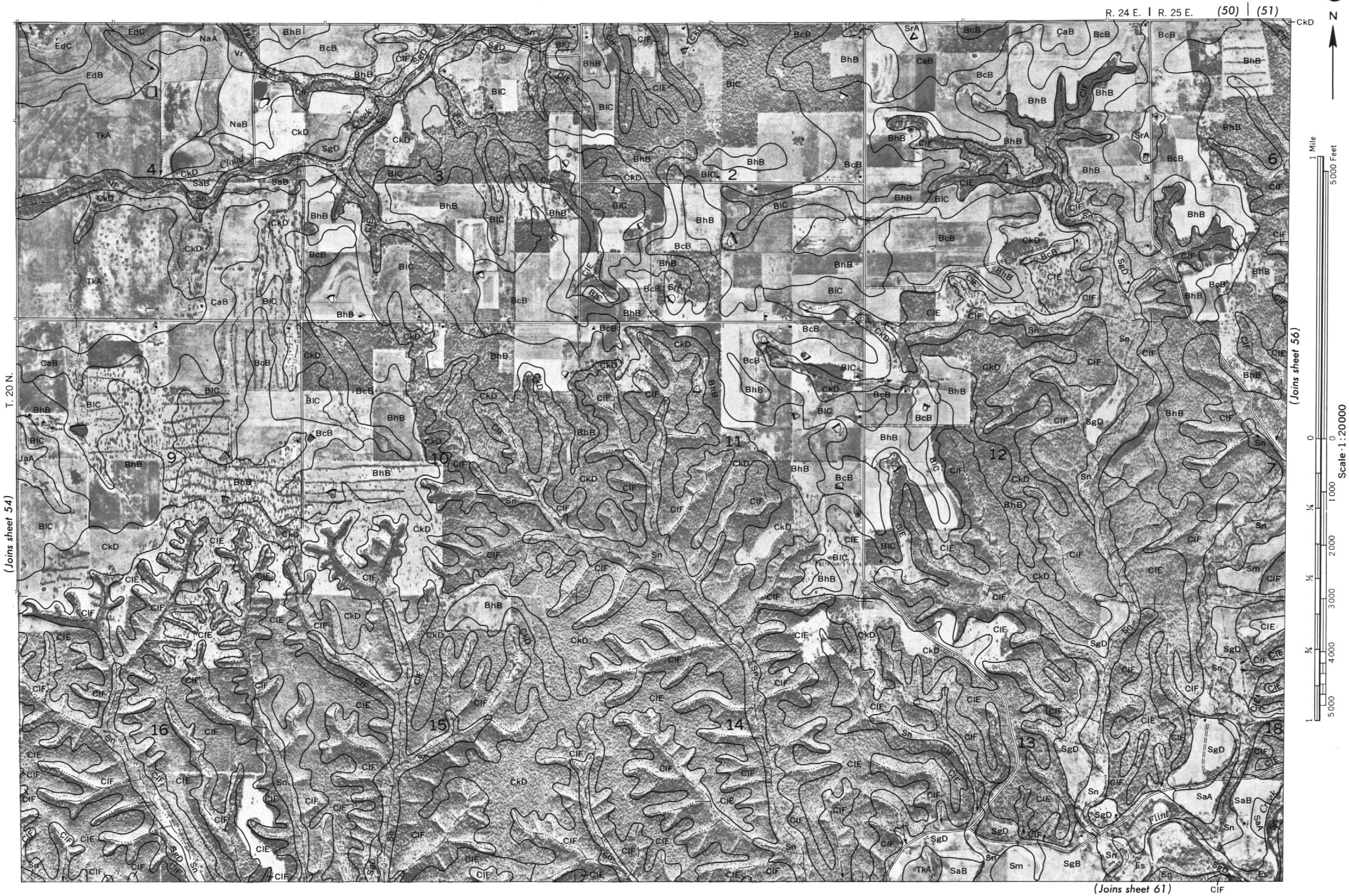
CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 54



CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 54

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.



This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

CHEROKEE AND DELAWARE COUNIES, OKLAHOMA NO. 55

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 56

N

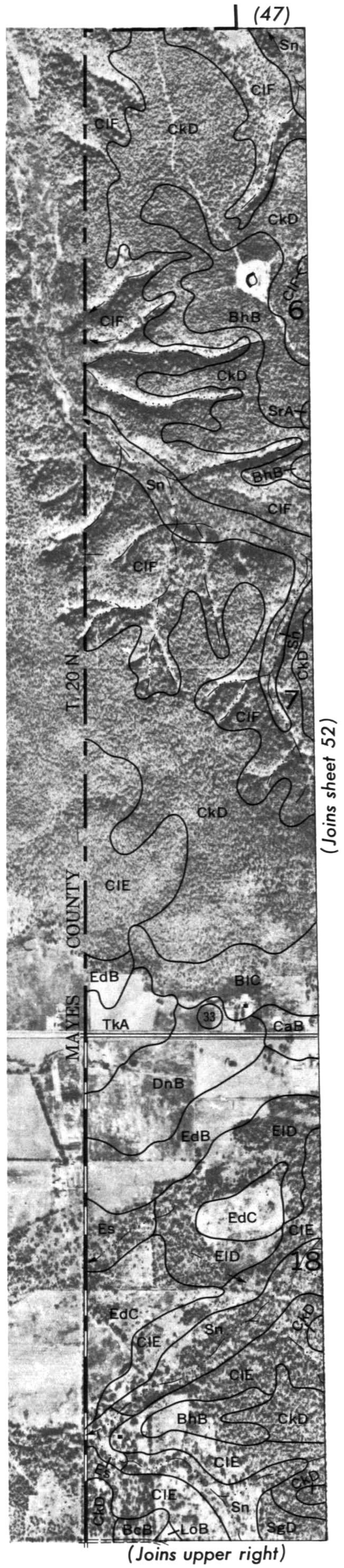
1 Mile
5000 Feet
0
1000
2000
3000
4000
5000
0
¼
½
¾
1
Scale 1:20000

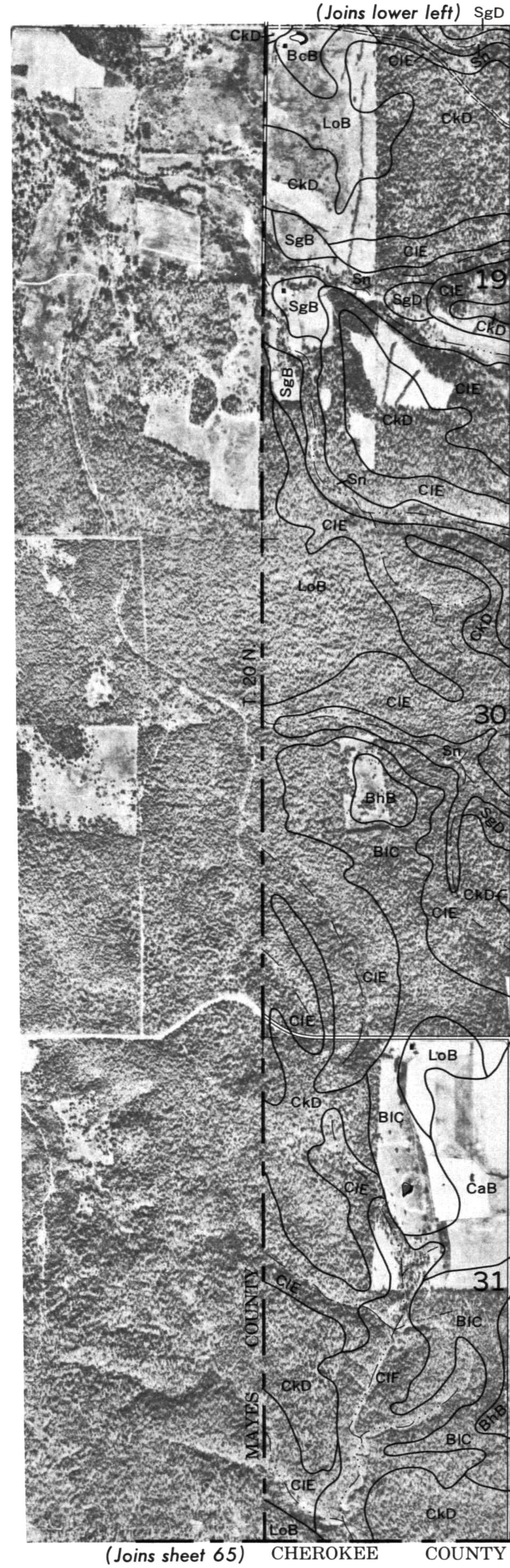
CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 56

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

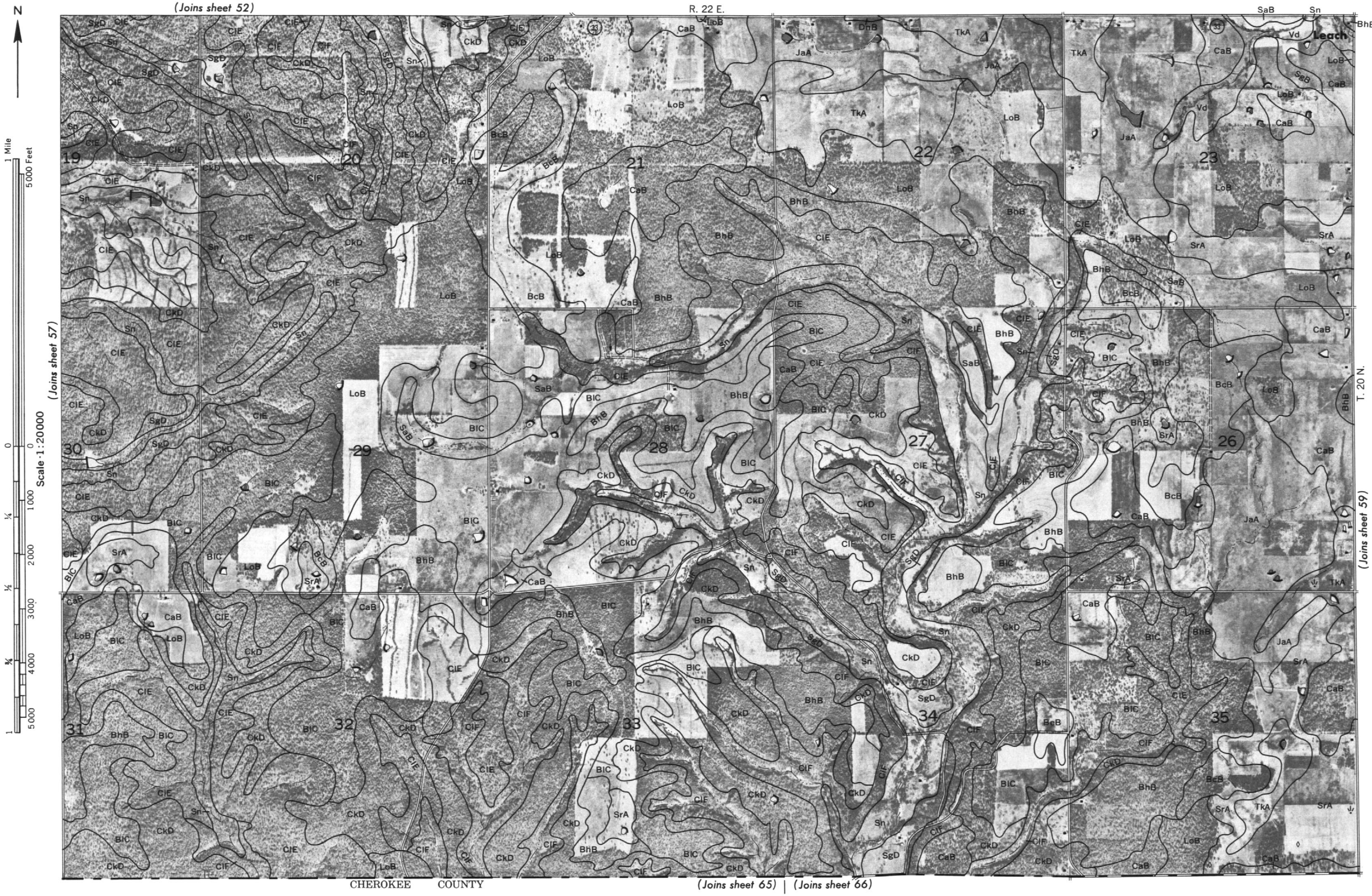
R. 22 E.





This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 58

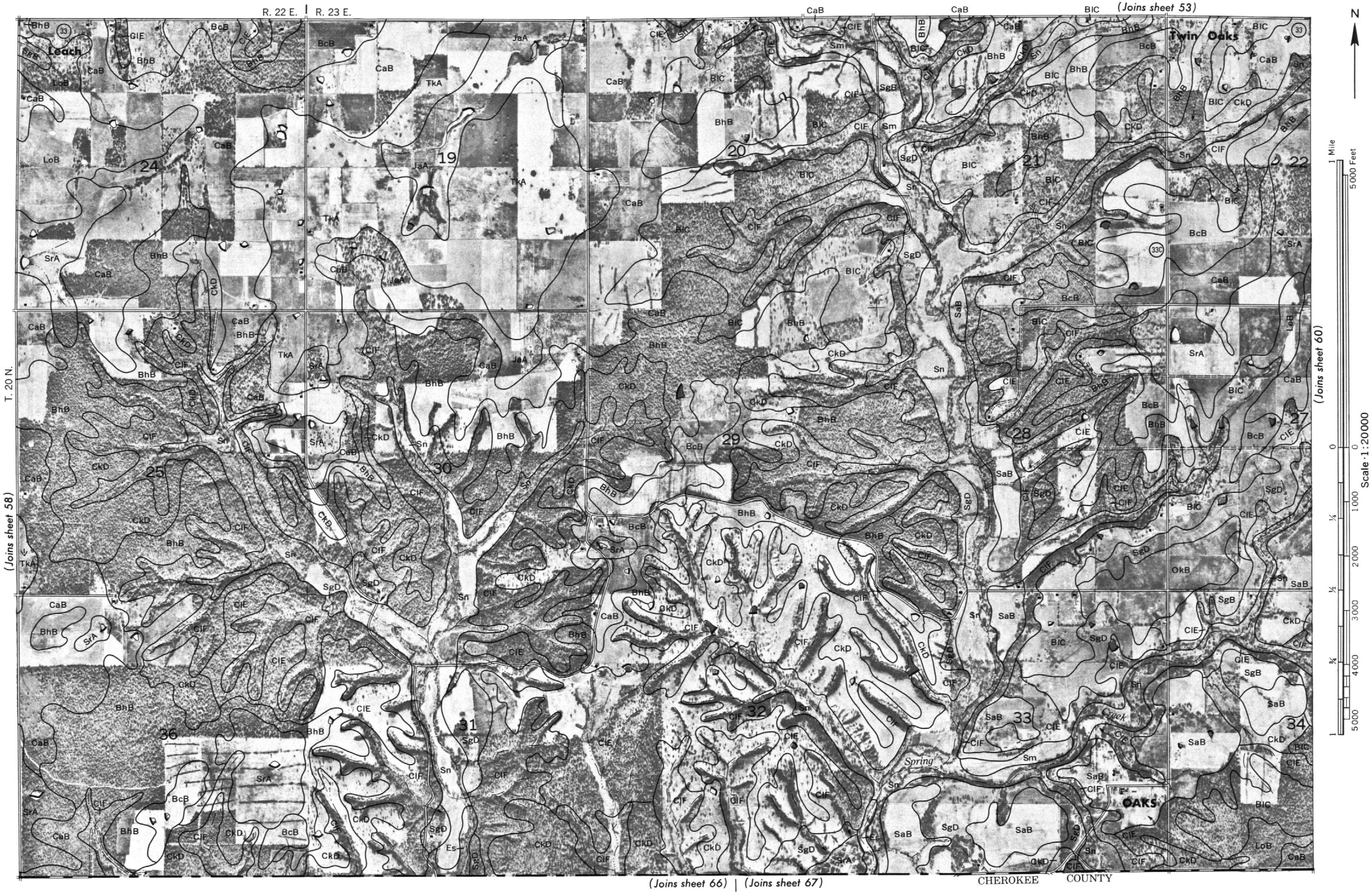


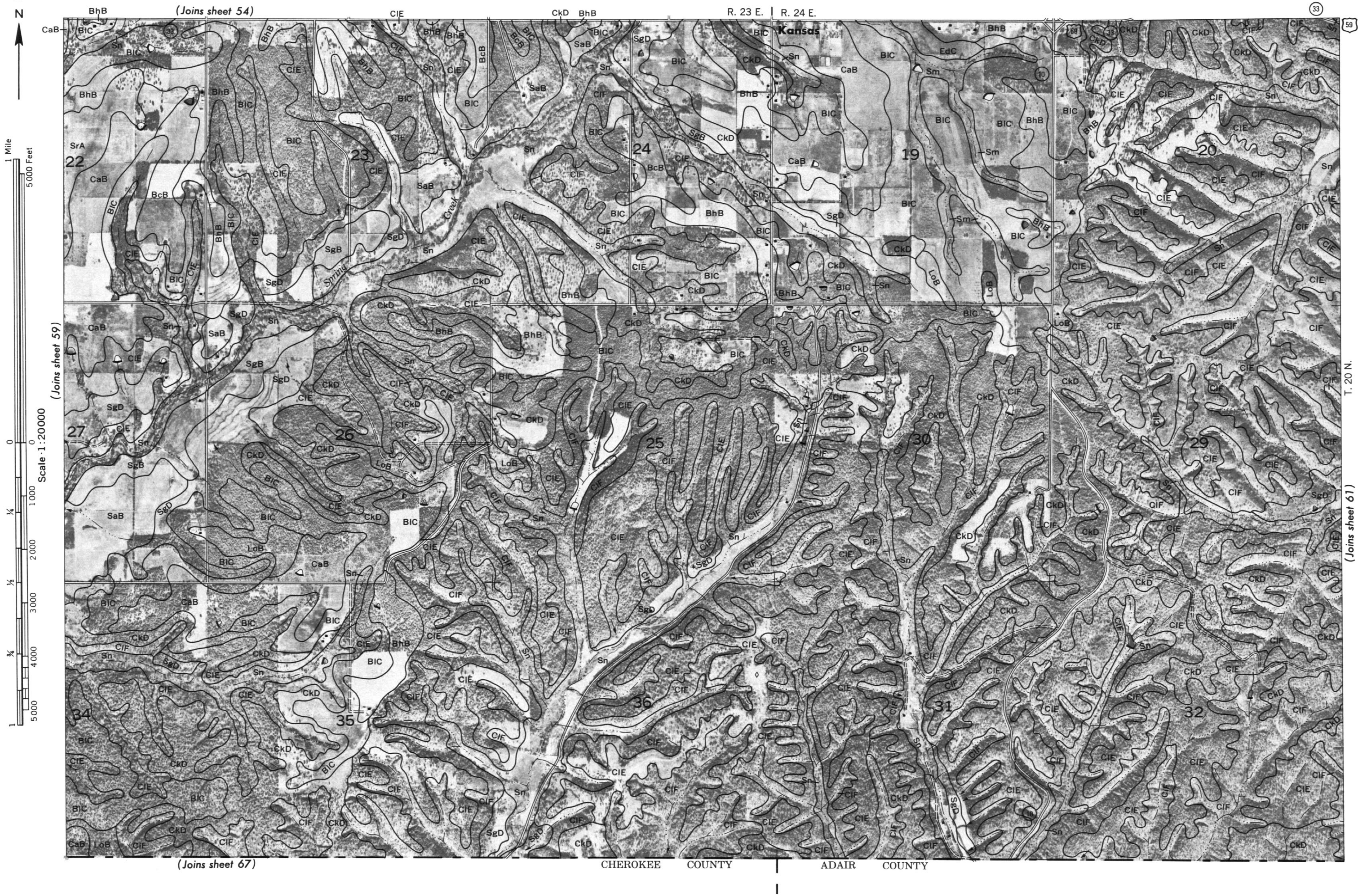
CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 58

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment station.
Land division corners are approximately positioned on this map.
CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 59

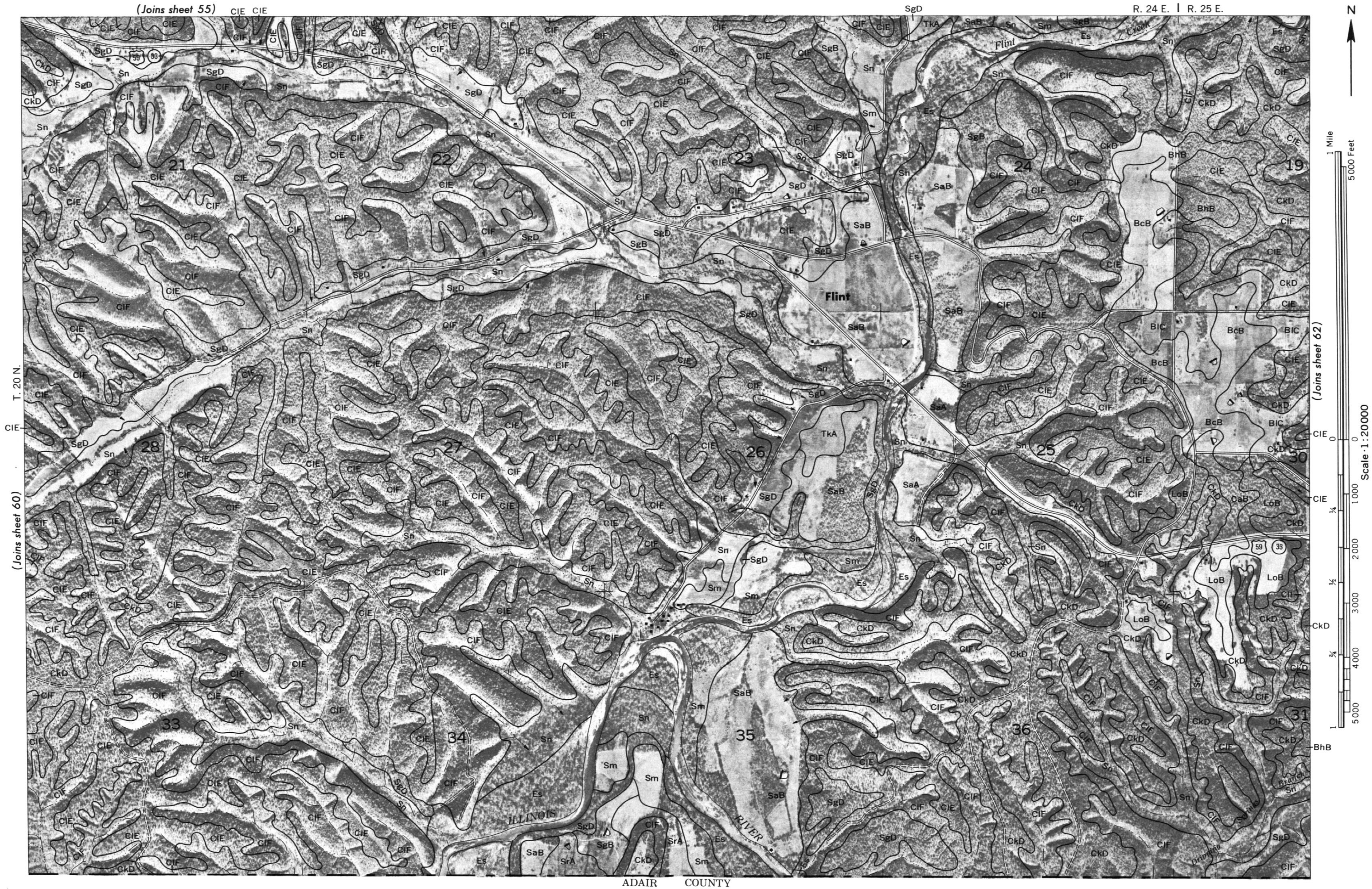




CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 60

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.



This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Land division corners are approximately positioned on this map.
CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 61

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 62

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 62

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

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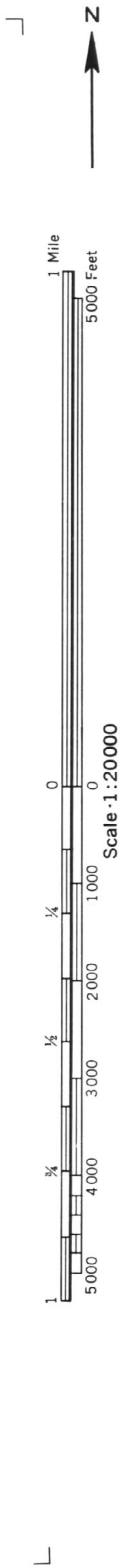
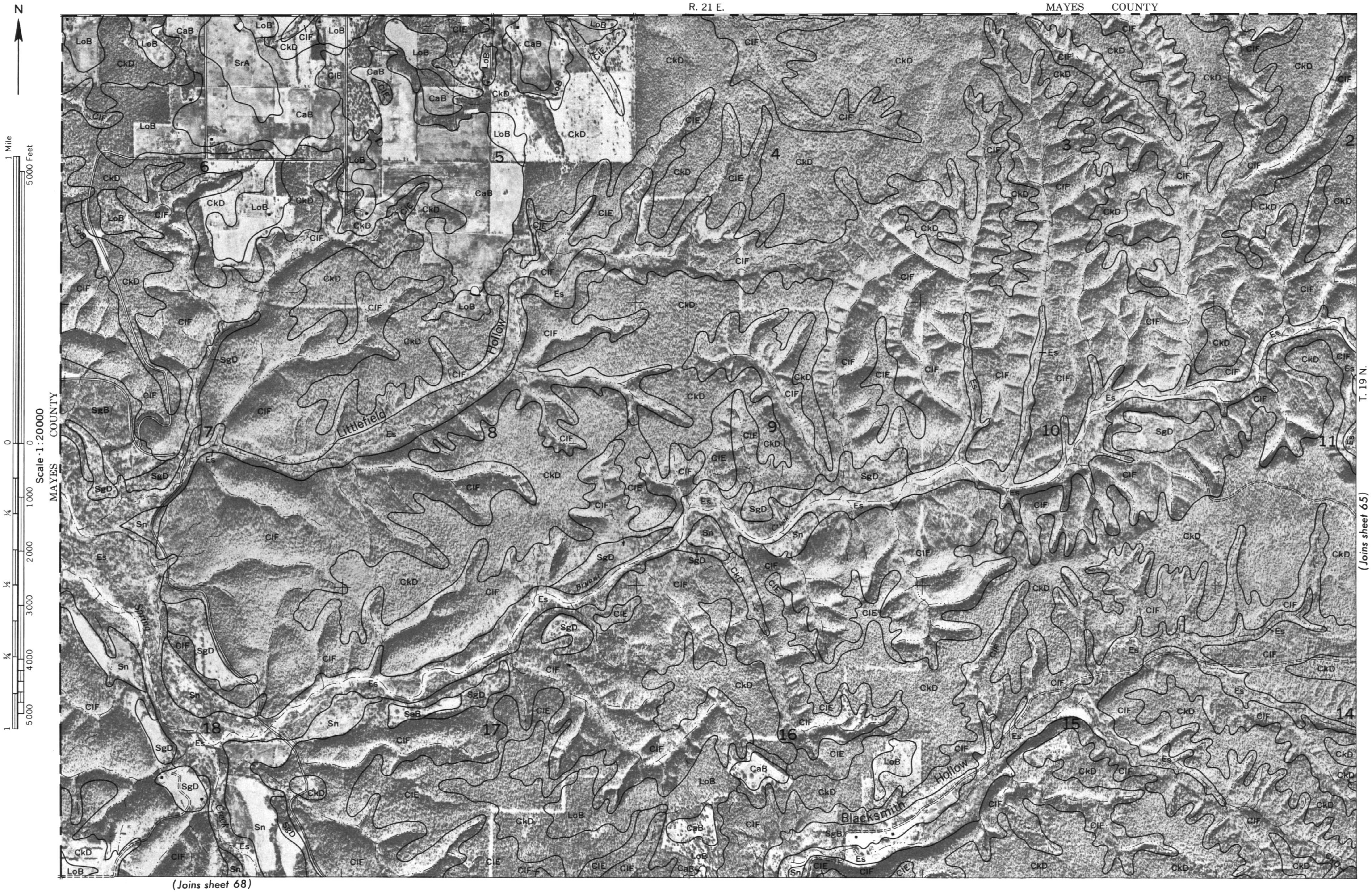
Land division corners are approximately positioned on this map.

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 63



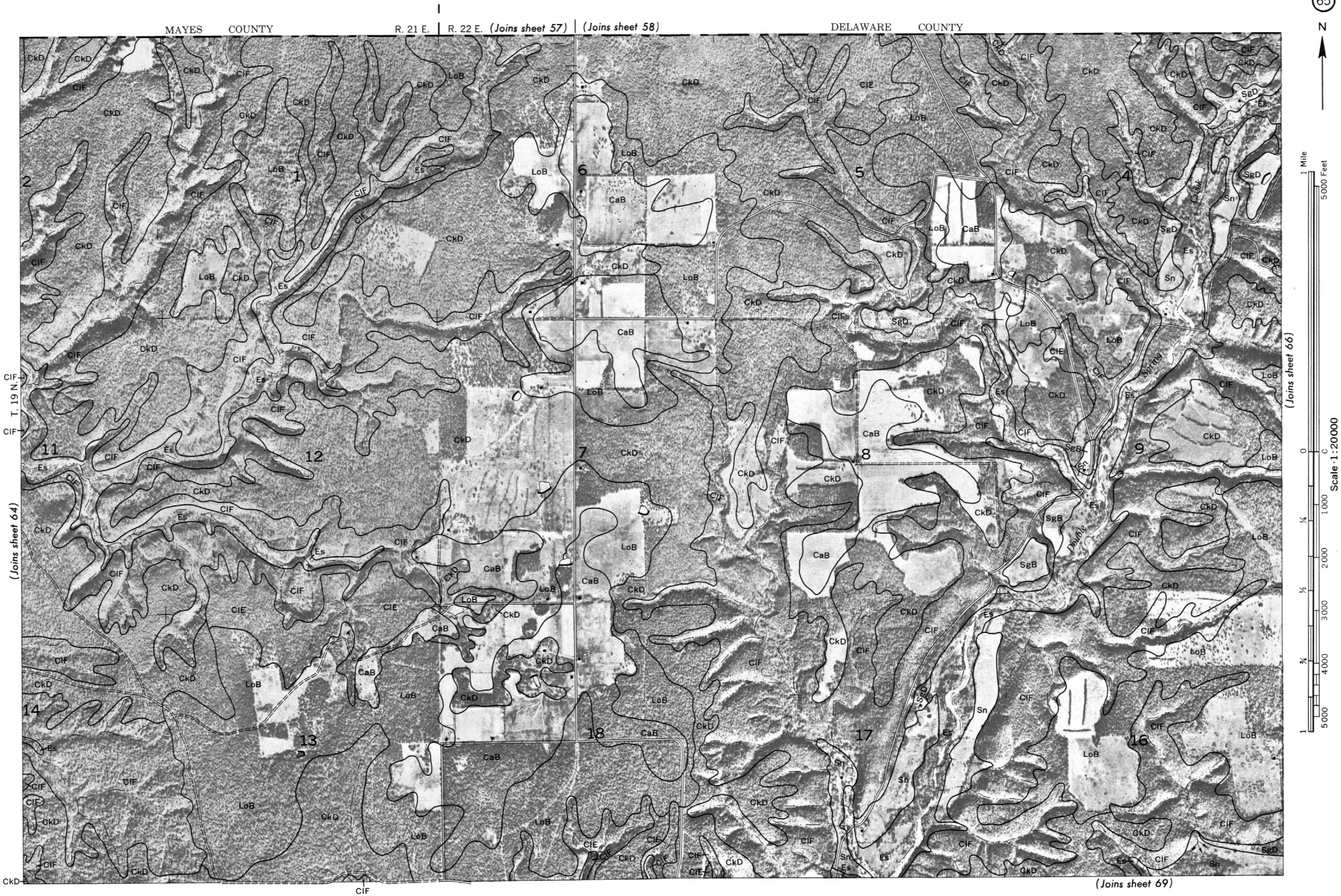
CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 64



CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 64

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.



This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Land division corners are approximately positioned on this map.
CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 65

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 66

N

1 Mile
5000 Feet

Scale 1:20000

0 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 66

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

(Joins sheet 59) | (Joins sheet 60)

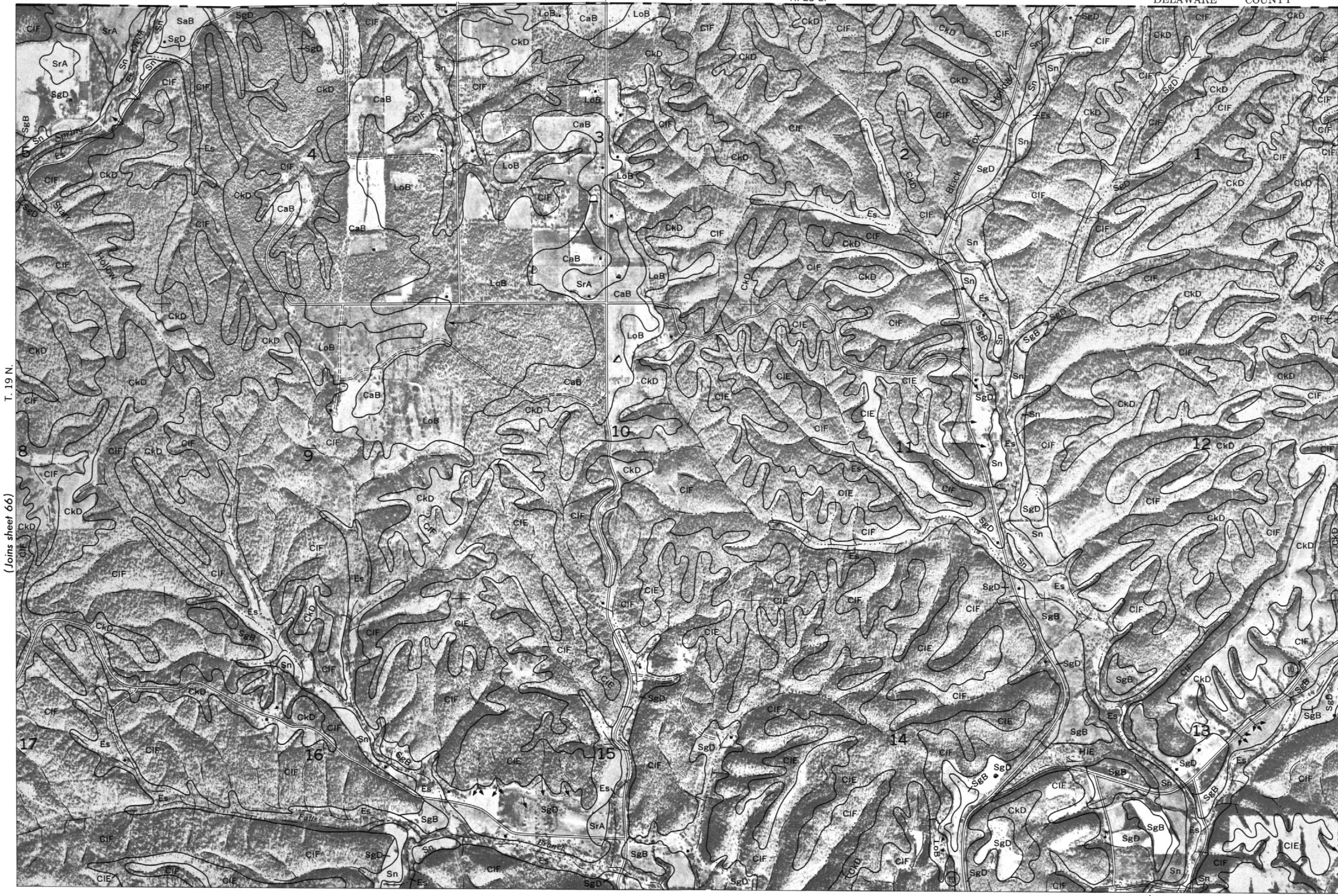
R. 23 E.

DELAWARE COUNTY

ADAIR COUNTY

T. 19 N.

(Joins sheet 66)



(Joins sheet 71)

N

1 Mile

5000 Feet

0 1000 2000 3000 4000 5000

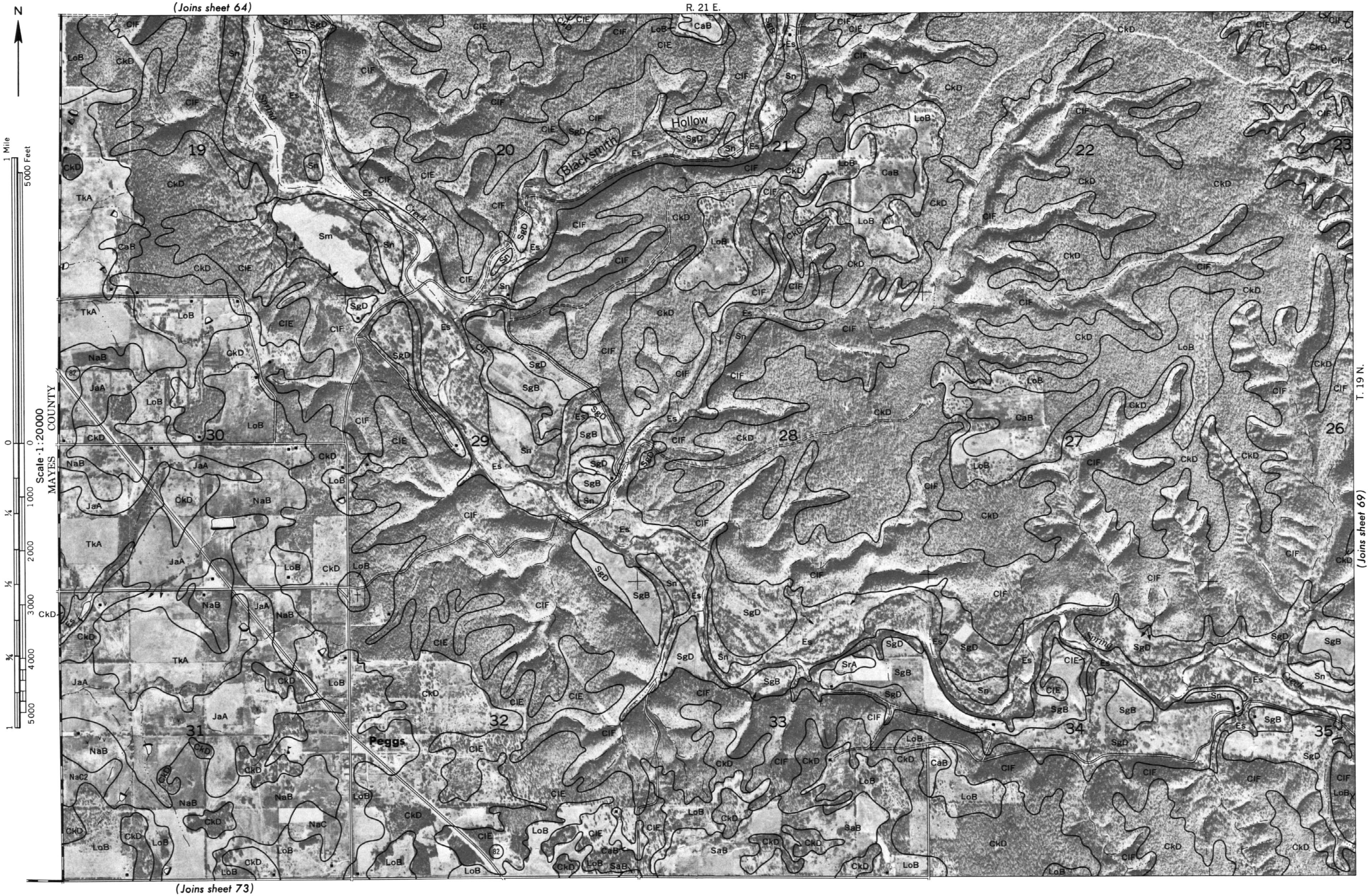
Scale 1:20000

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 67

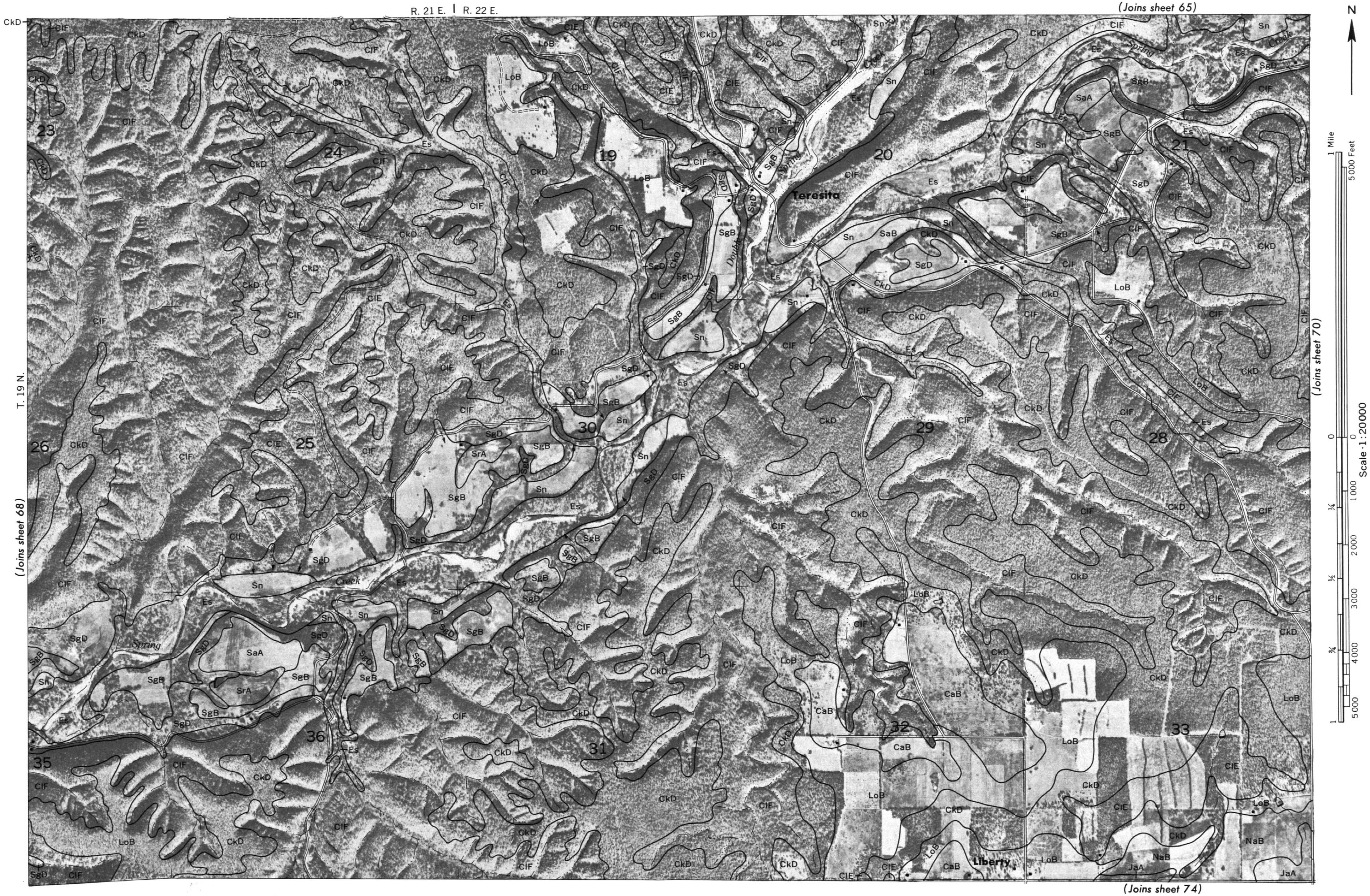
CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 68



CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 68

Land division corners are approximately positioned on this map.

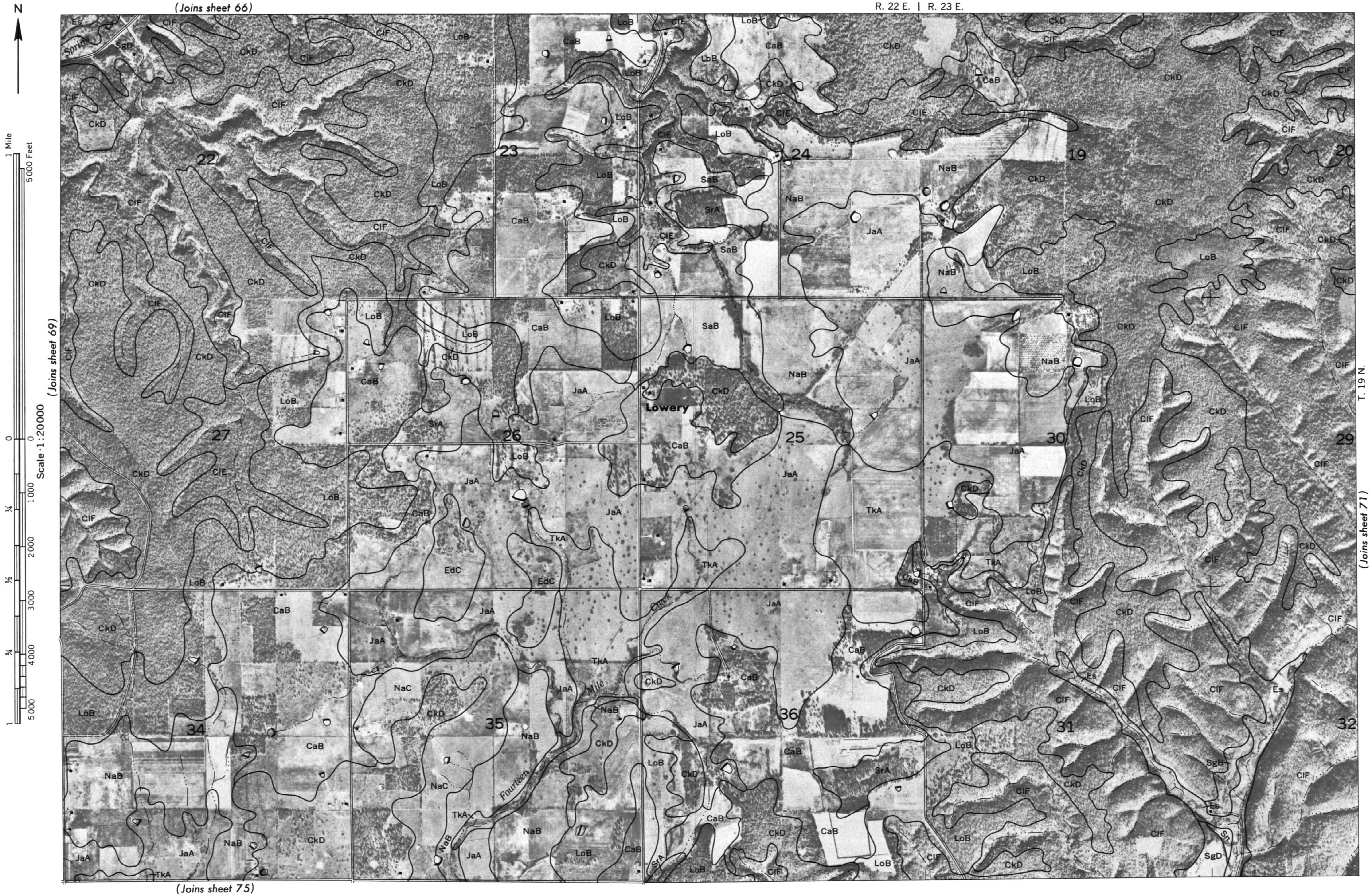
This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.



This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

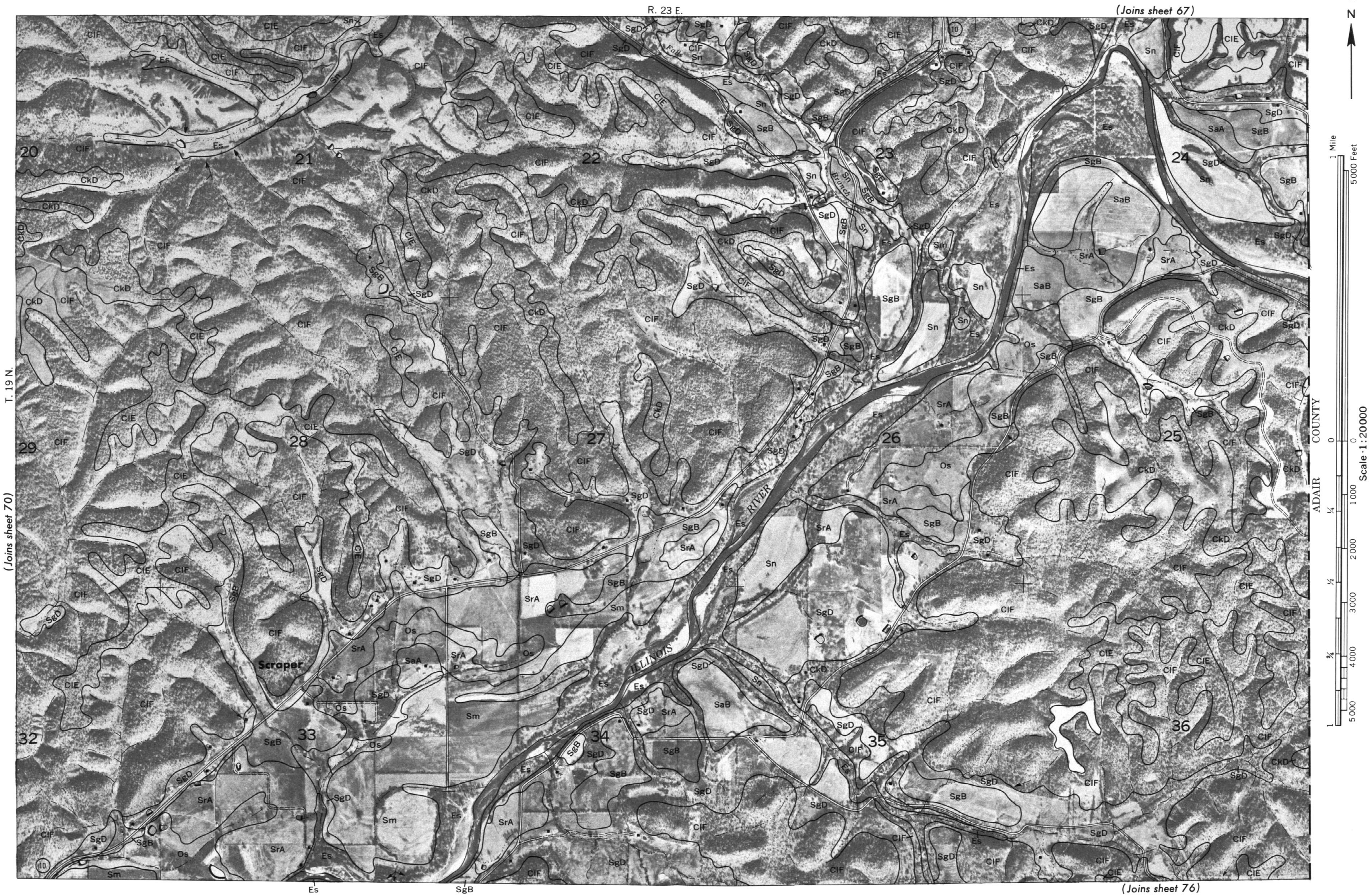
CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 70



CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 70

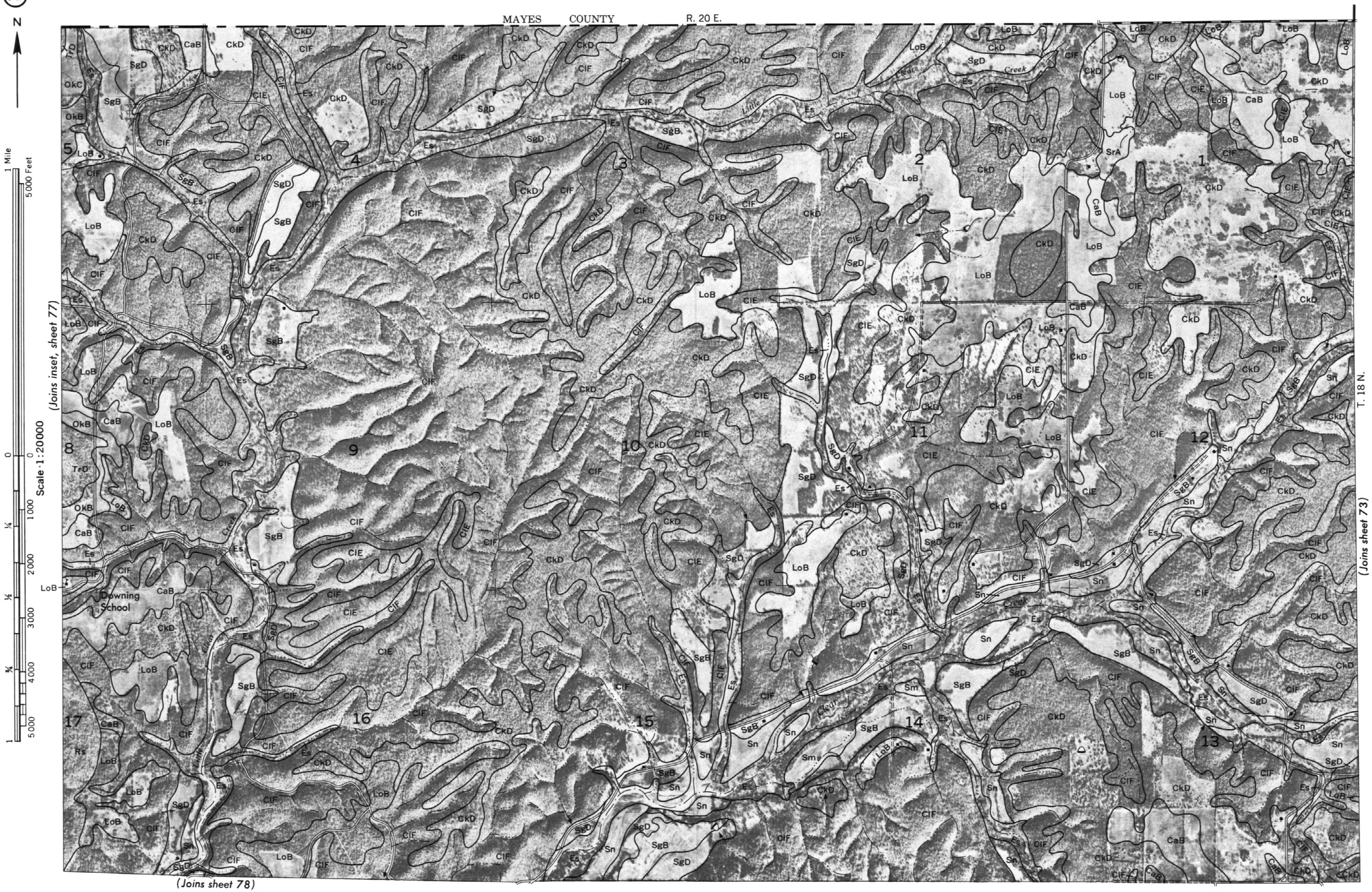
Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station



This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Land division corners are approximately positioned on this map.
CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 71

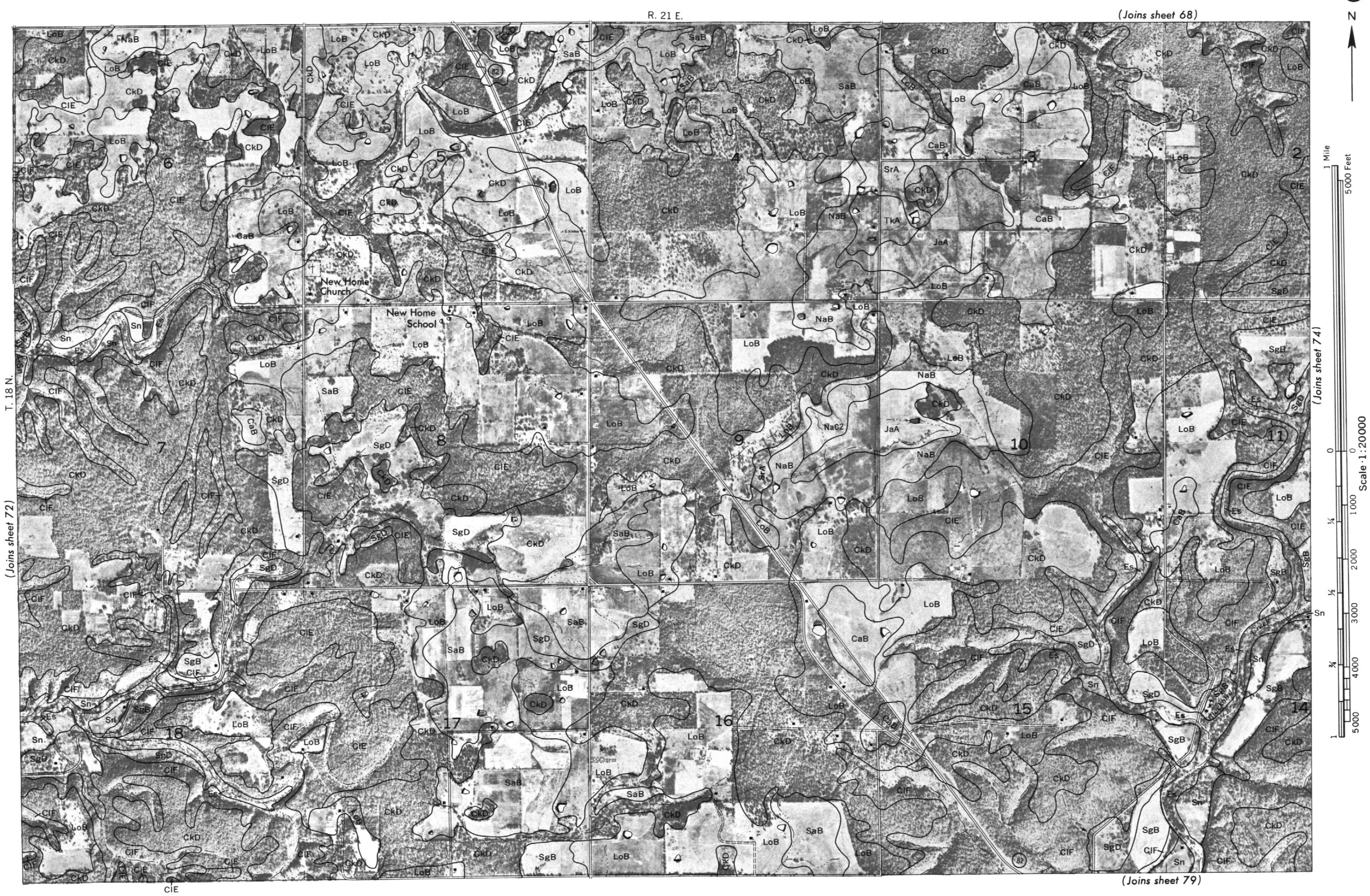
CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 72



CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 72

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.



This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 73

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 74

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 74

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

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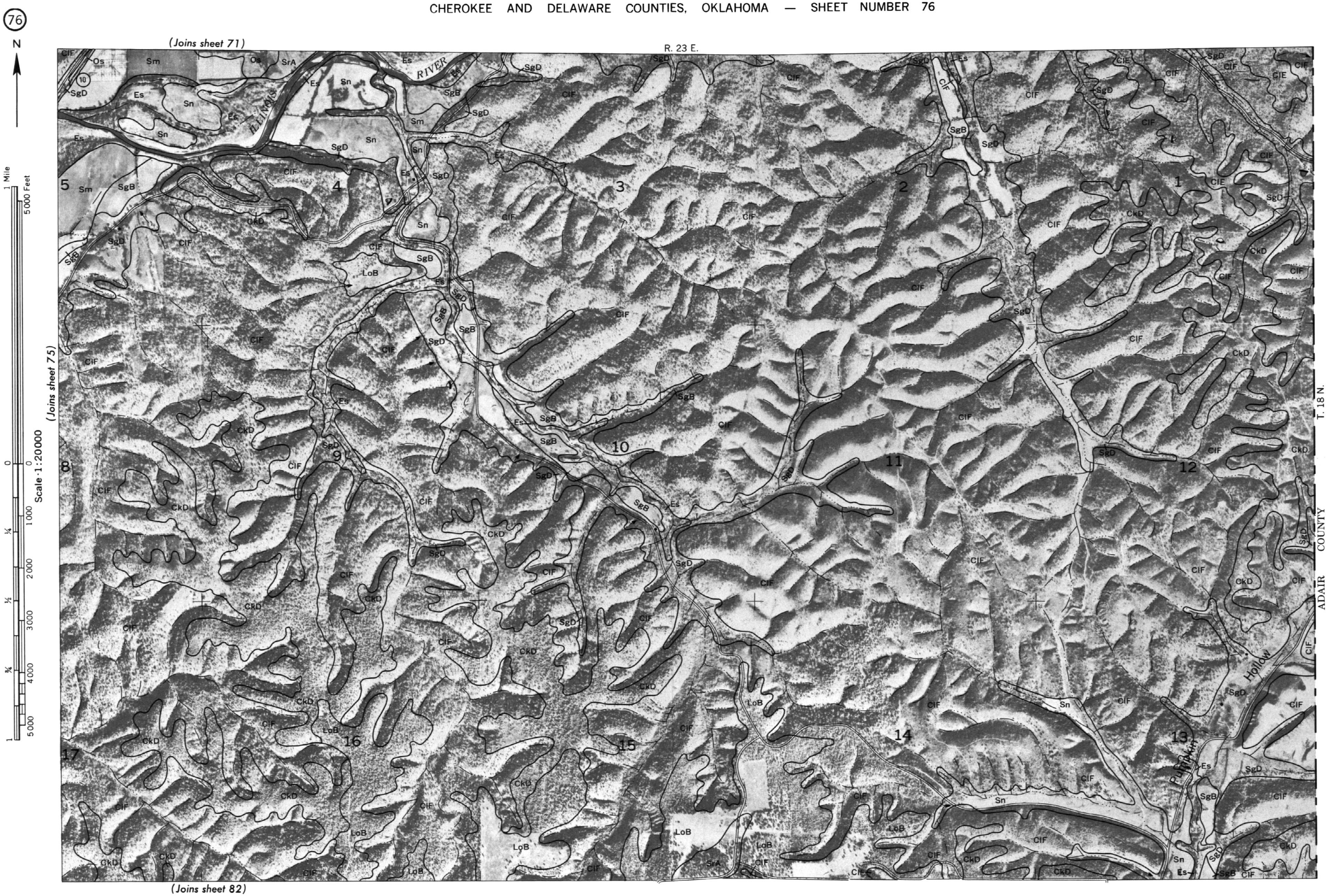
Land division corners are approximately positioned on this map.

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 75



CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 76

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

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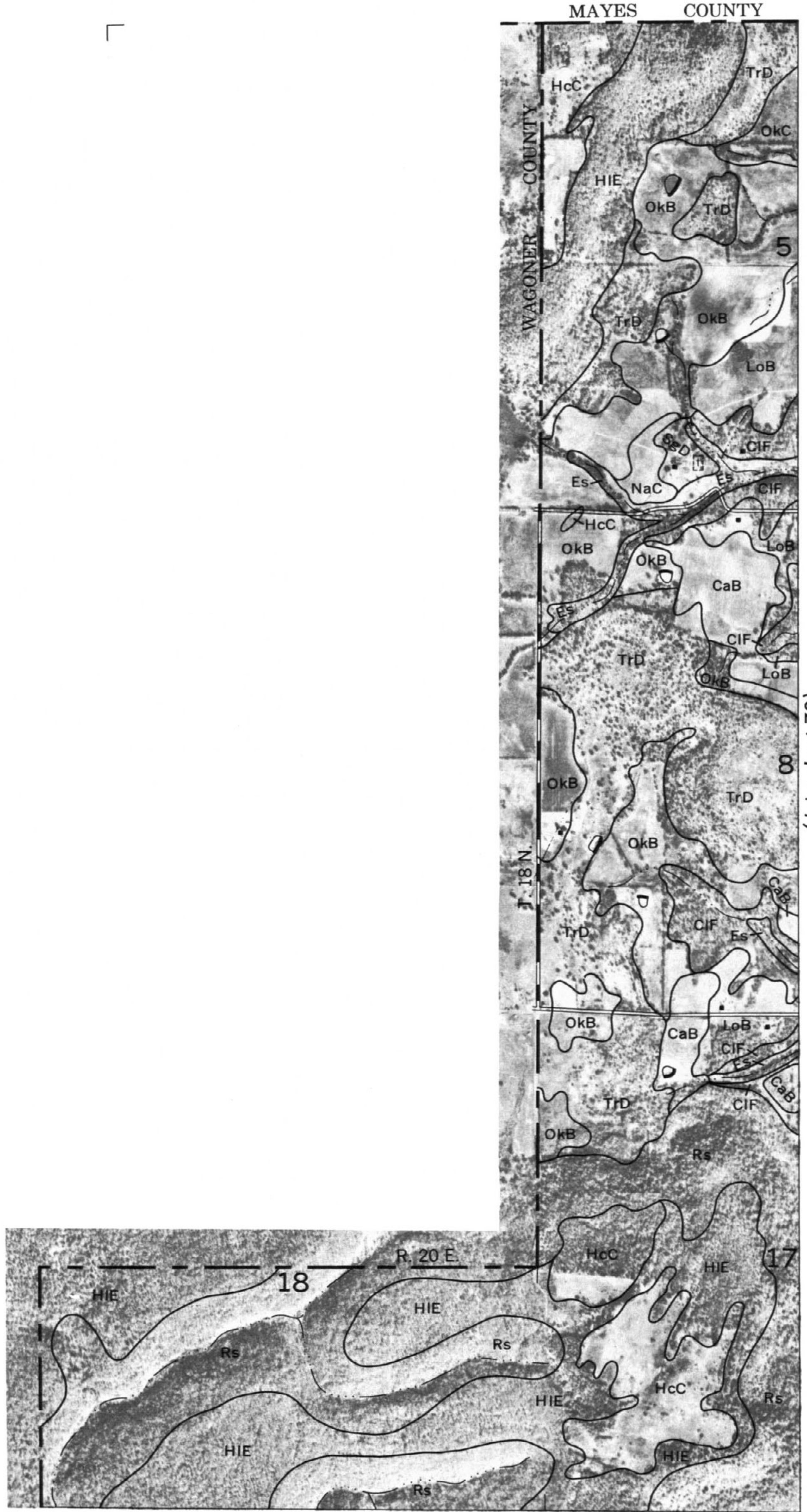
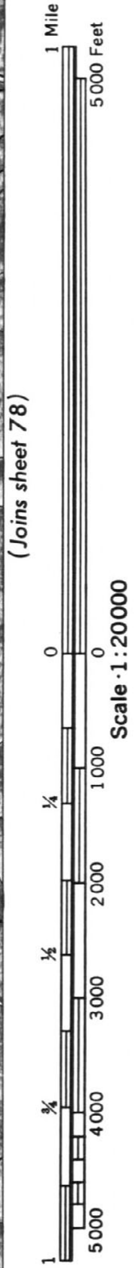
Land division corners are approximately positioned on this map.
CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 77



77
N



N

Scale 1:20000

1 Mile

5000 Feet

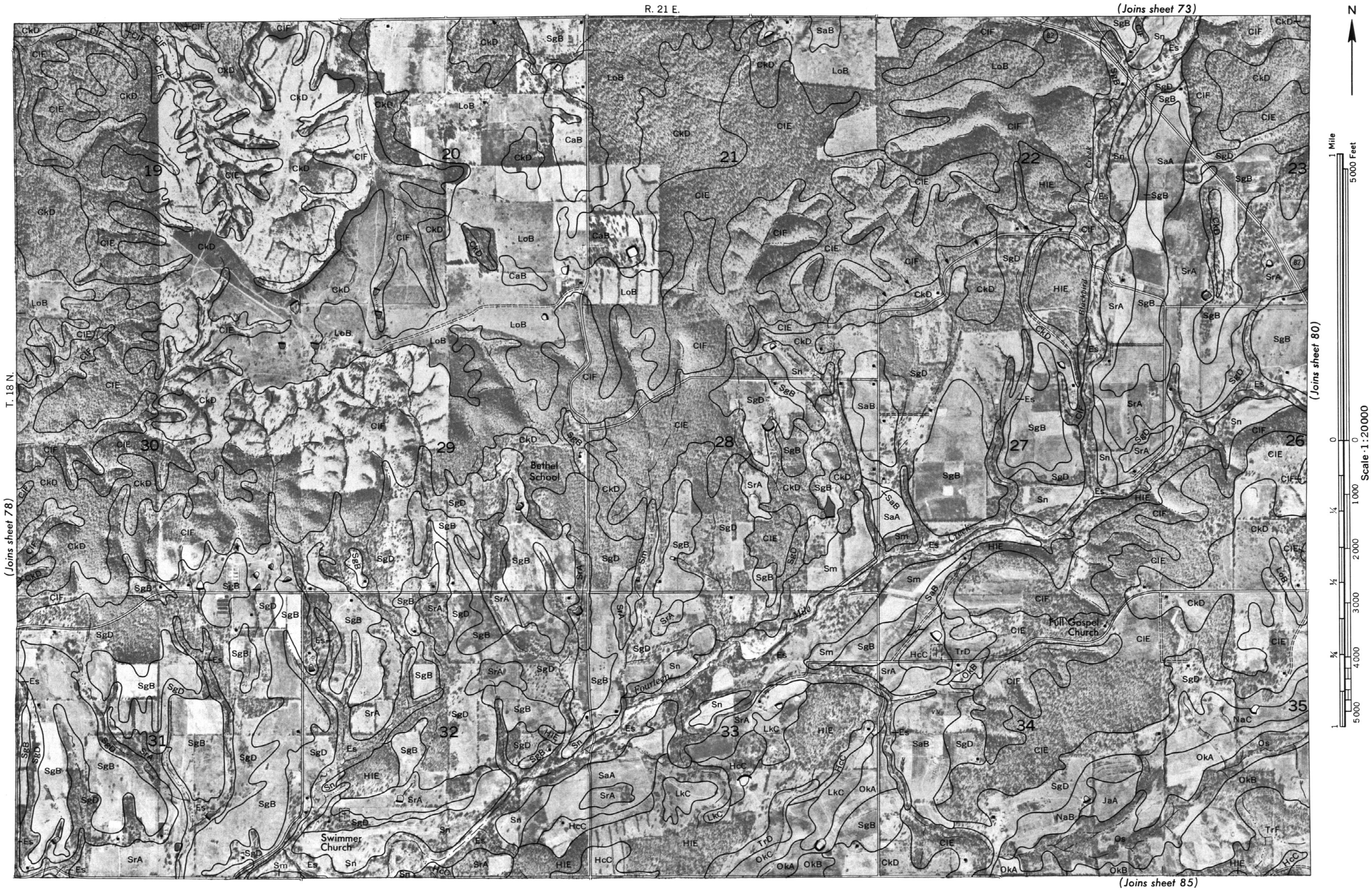
0 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 78

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.



This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Land division corners are approximately positioned on this map.
CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 79

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 80

N

(Joins sheet 74)

R. 21 E. | R. 22 E.

(Joins sheet 79)

T. 18 N.

(Joins sheet 81)

(Joins sheet 86)

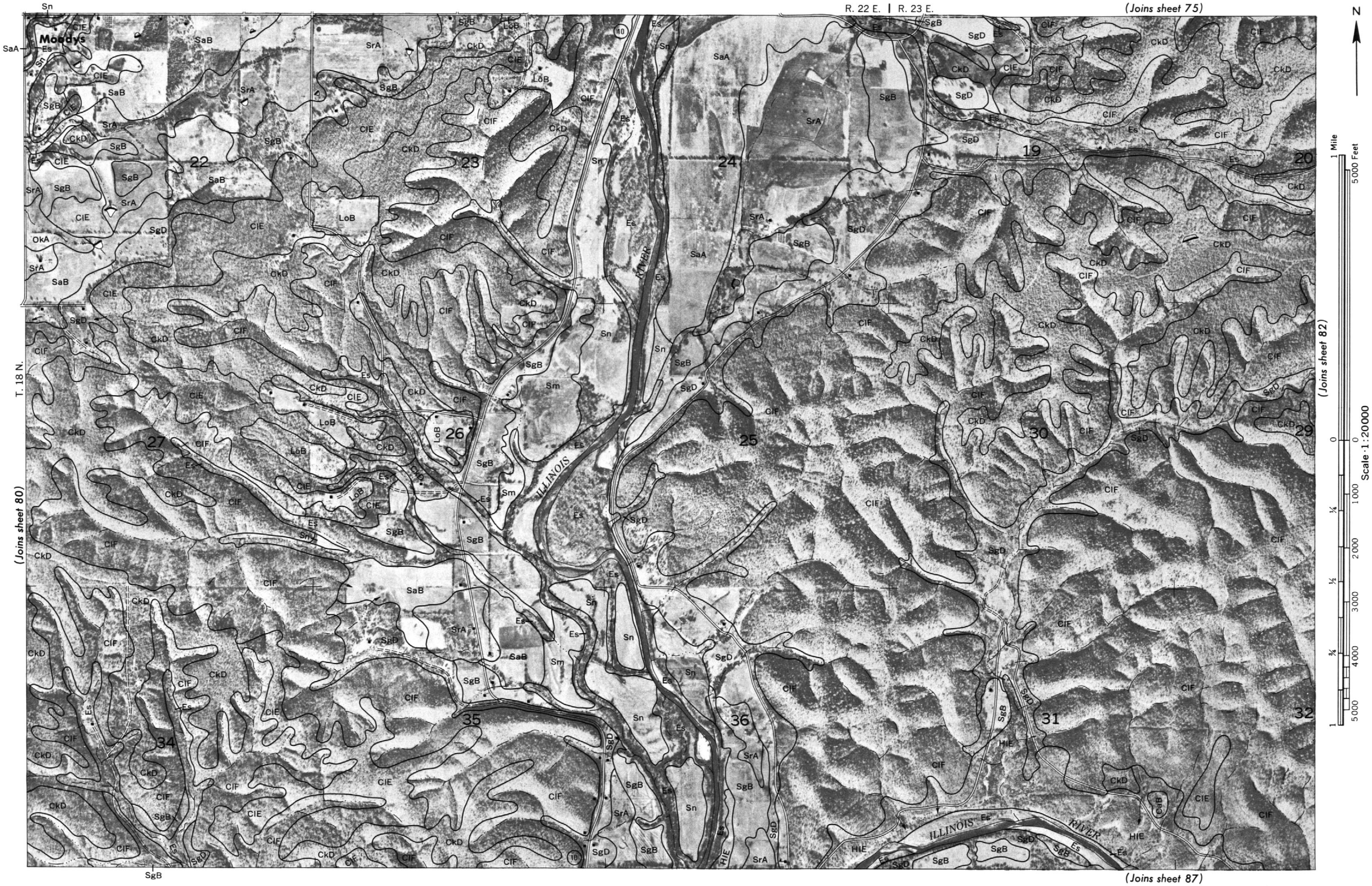
Scale 1:20000

1 Mile | 5000 Feet | 4000 | 3000 | 2000 | 1000 | 0

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 80

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.



This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

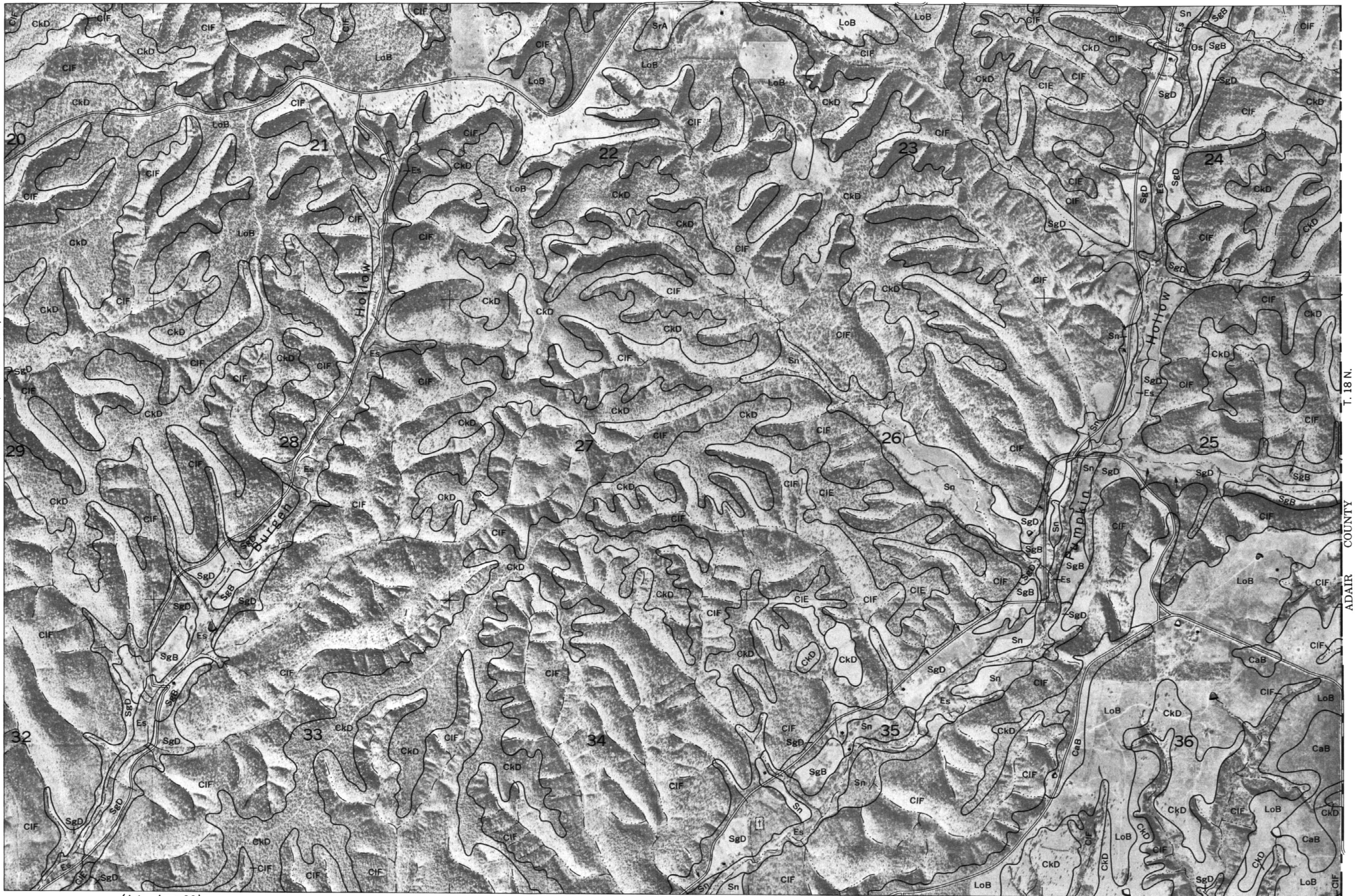
CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 81

N

Scale 1:20000

1 Mile 5000 Feet

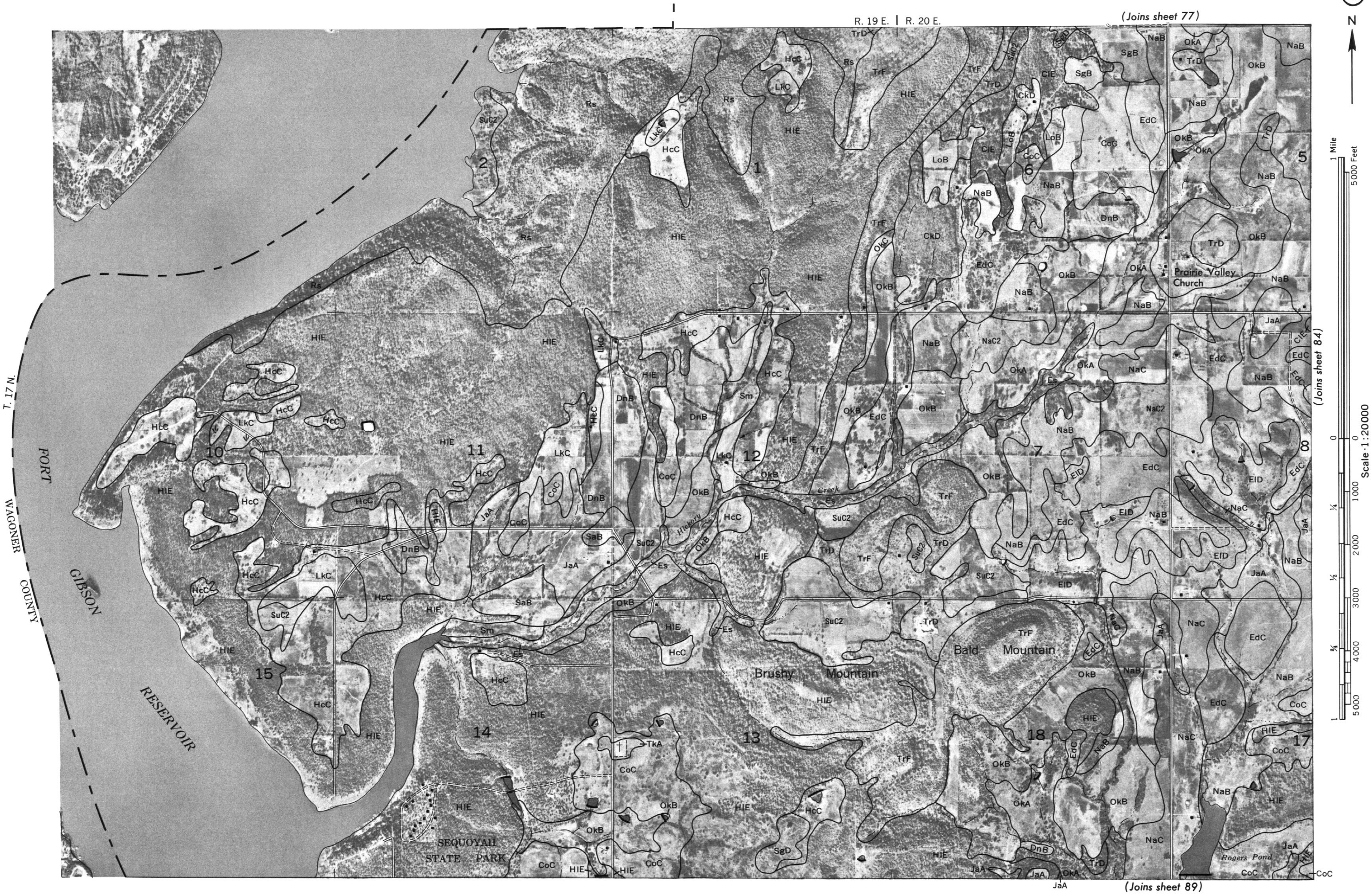
(Joins sheet 76)



CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 82

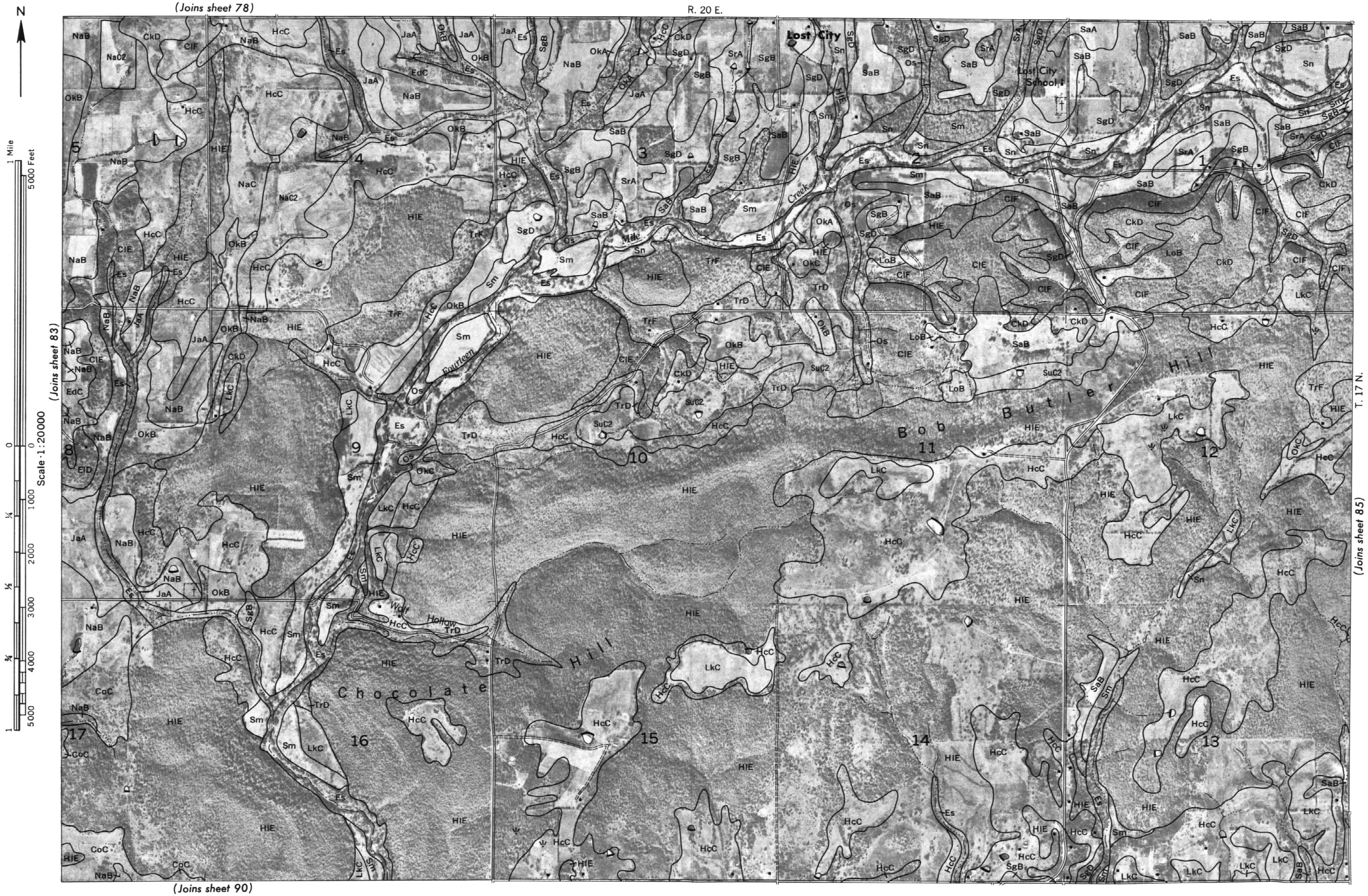
Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.



This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 83



CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 84

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

85

Scale 1:20000

1 Mile

5000 Feet

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

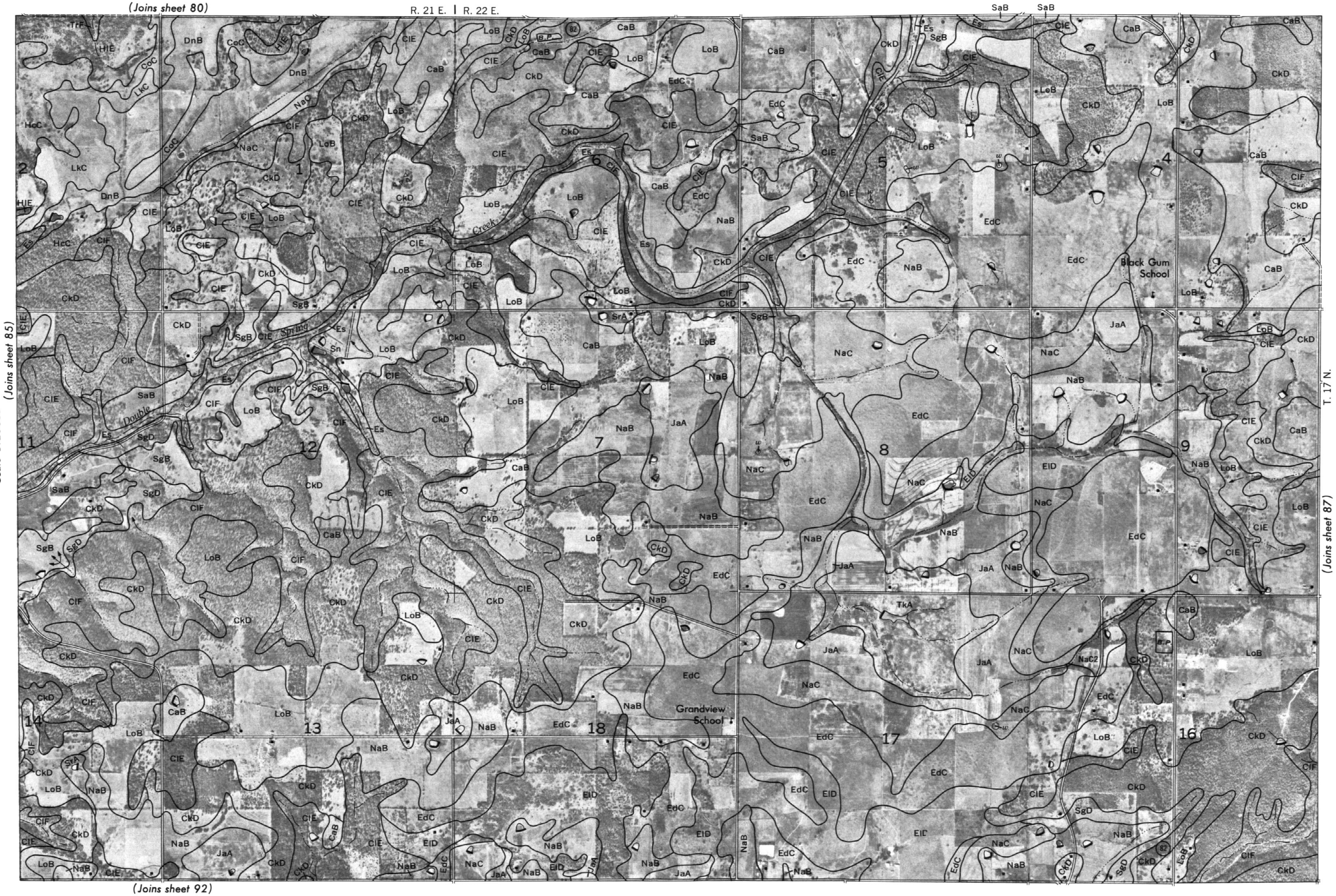
Land division corners are approximately positioned on this map.

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 85

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 86

N

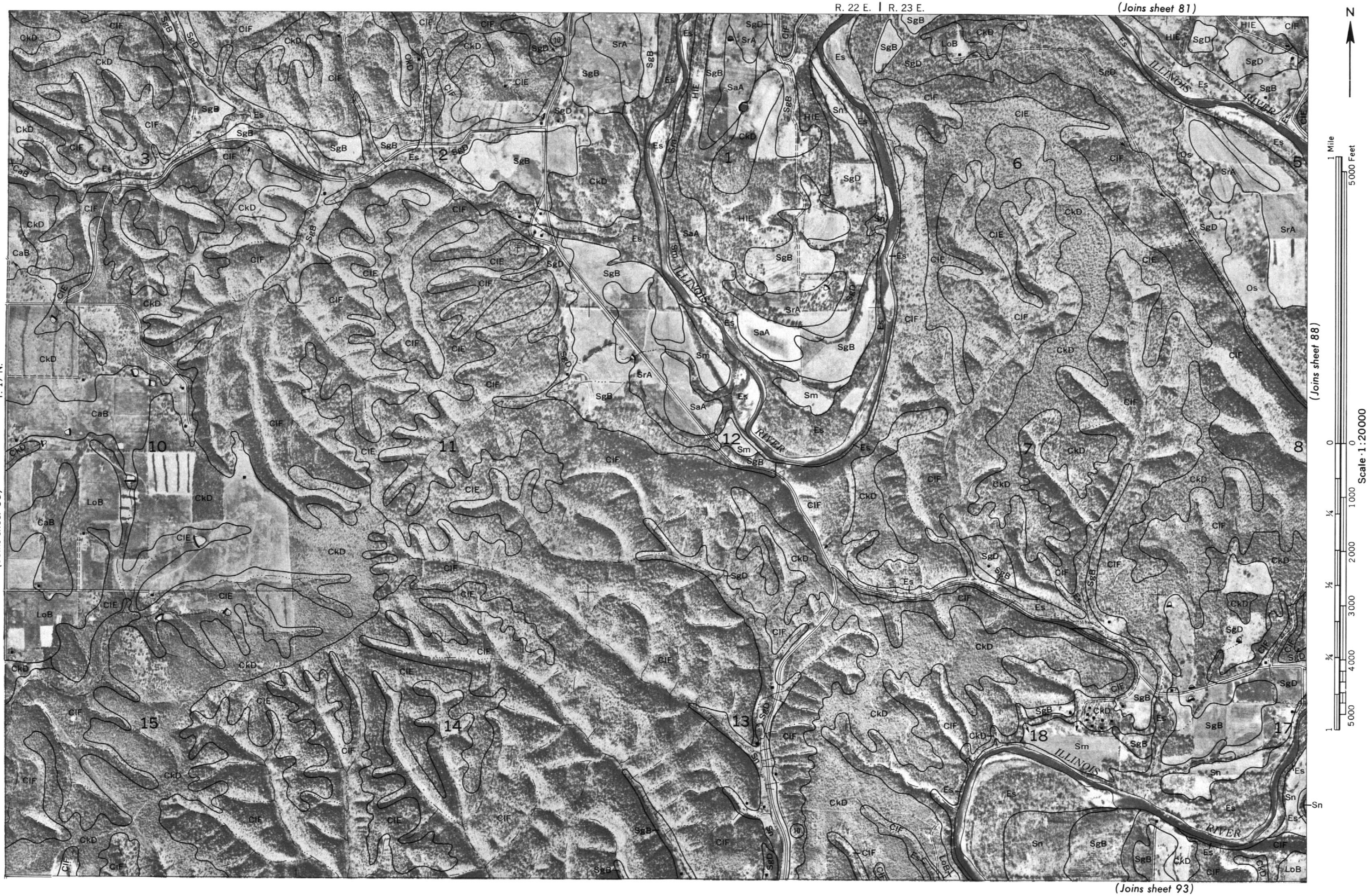
1 Mile
5000 Feet
0
0
Scale 1:20000
1000
2000
3000
4000
5000



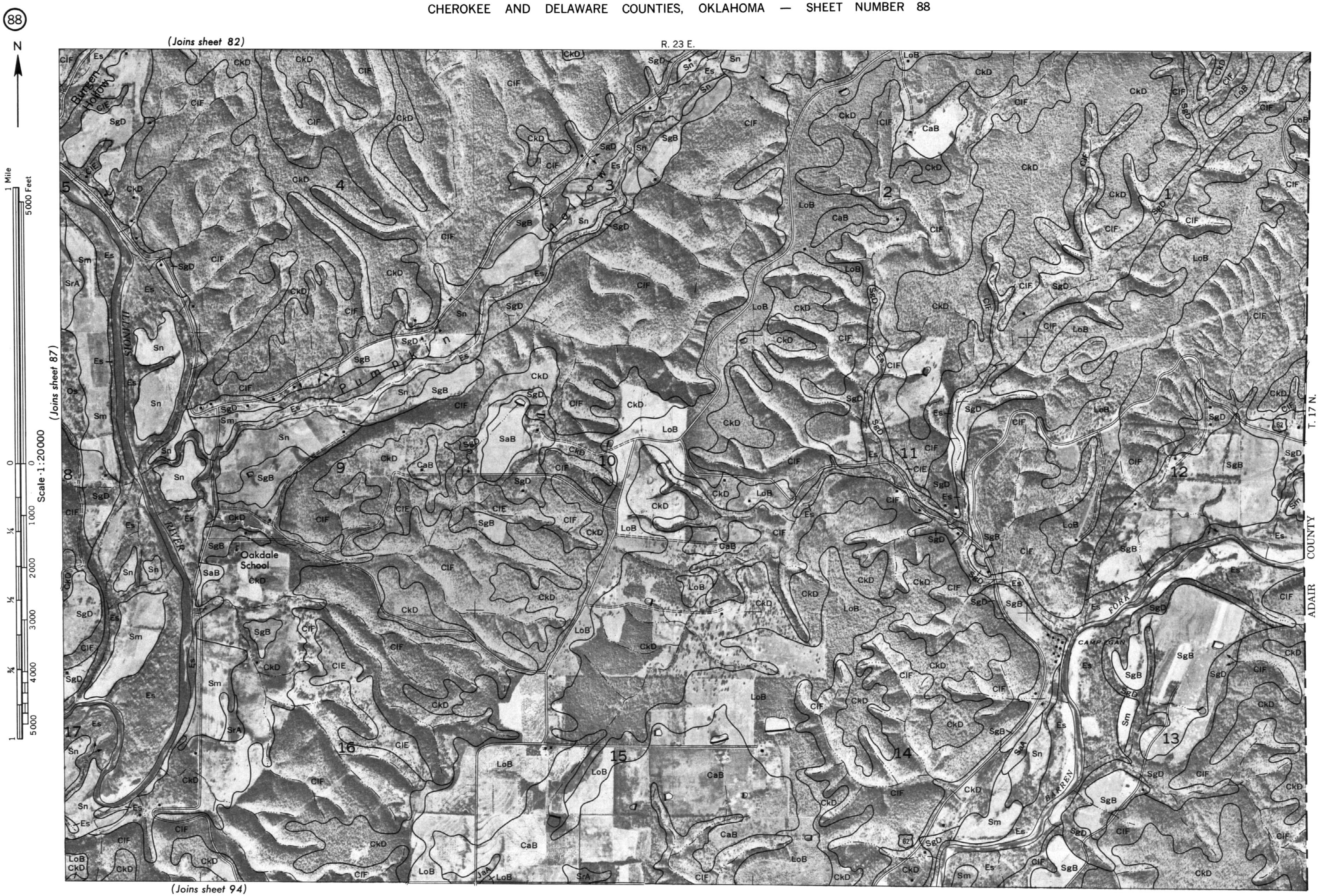
CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 86

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.



This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Land division corners are approximately positioned on this map.
CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 87



CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 88

Land division corners are approximately positioned on this map.

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Land division corners are approximately positioned on this map.

N

1 Mile
5000 Feet

Scale 1:20000

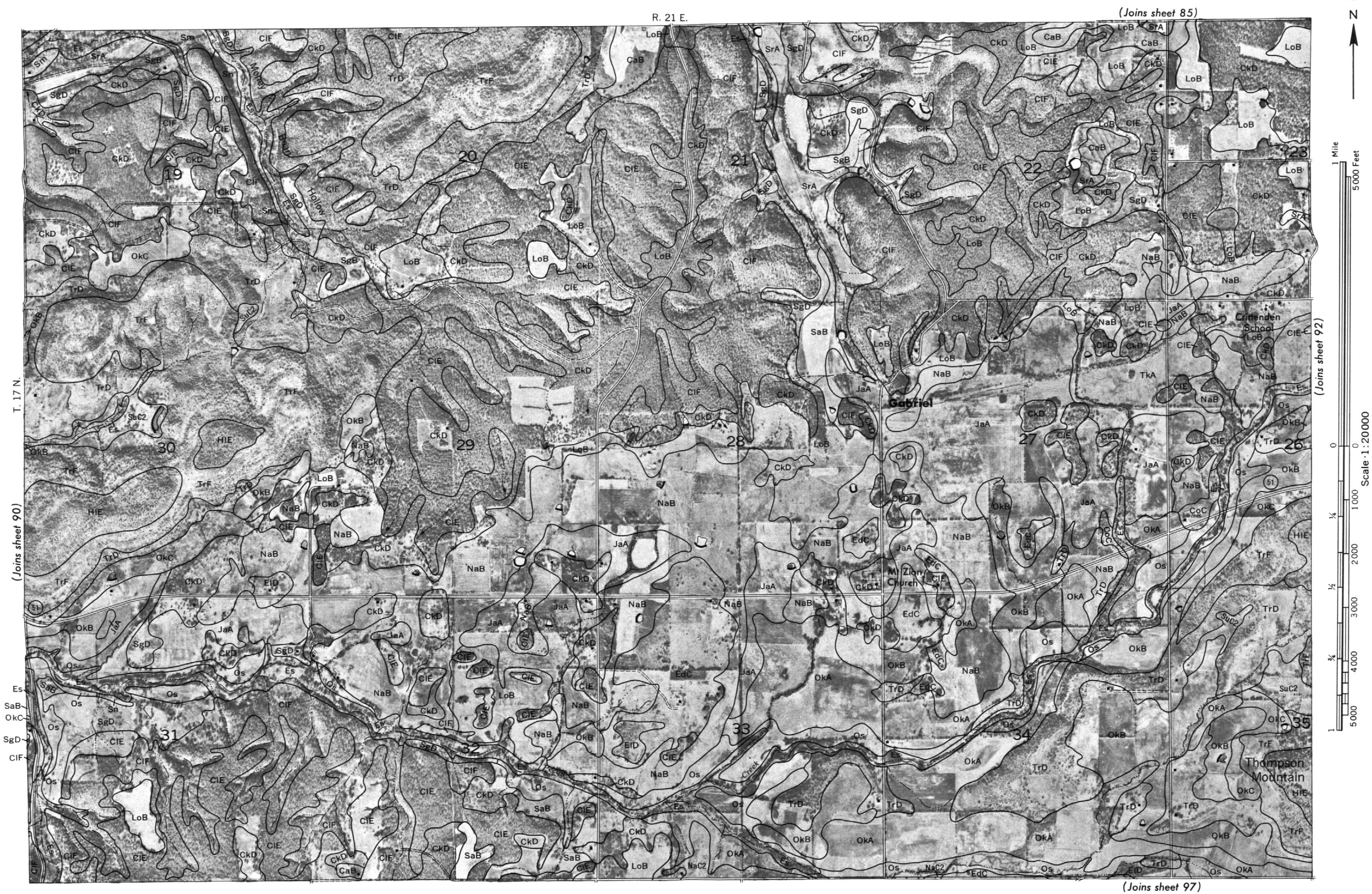
0 1000 2000 3000 4000 5000

0 ¼ ½ ¾ 1

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 90

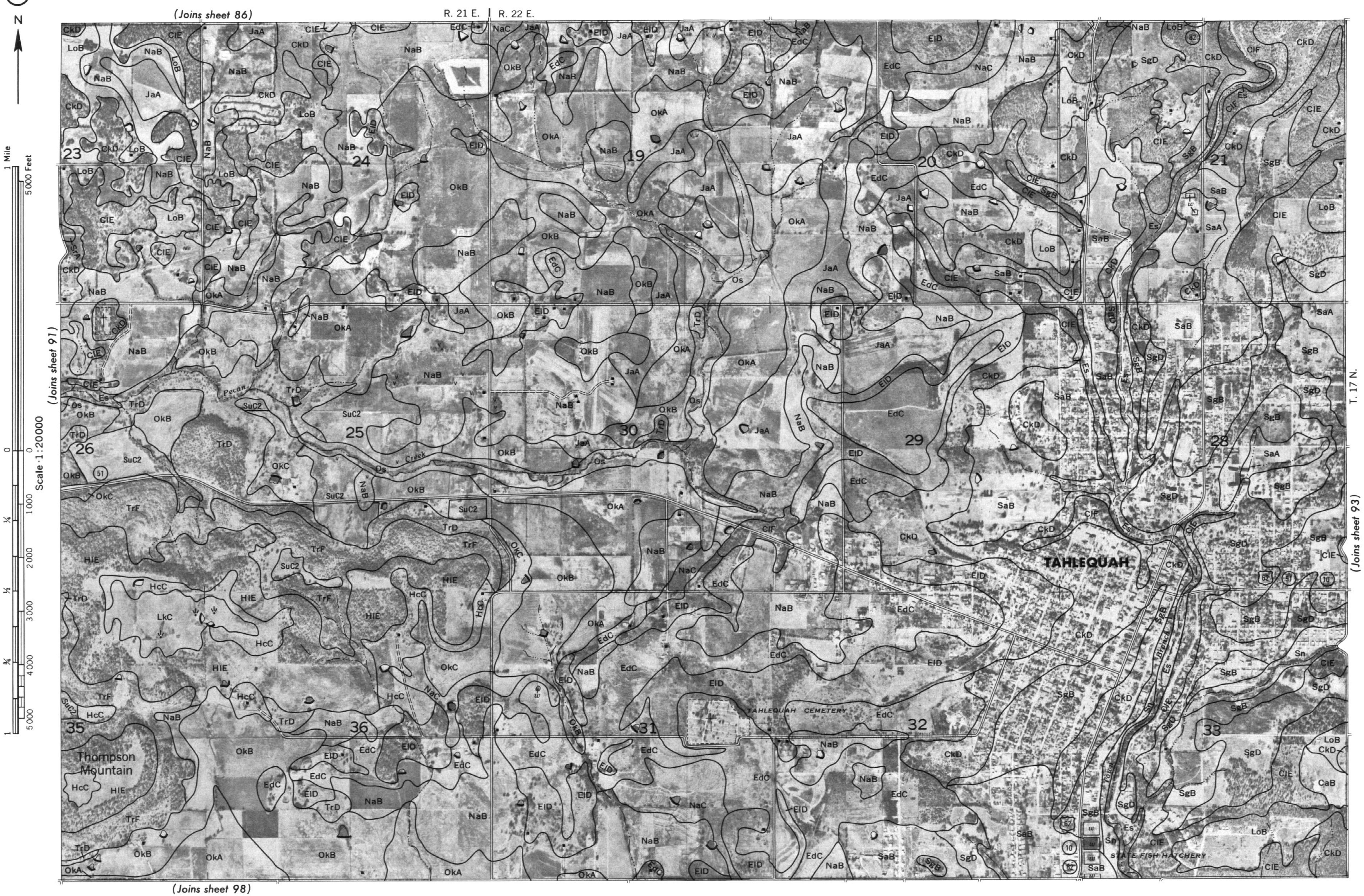
Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.



This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Land division corners are approximately positioned on this map.
CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 91

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 92



CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 92

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

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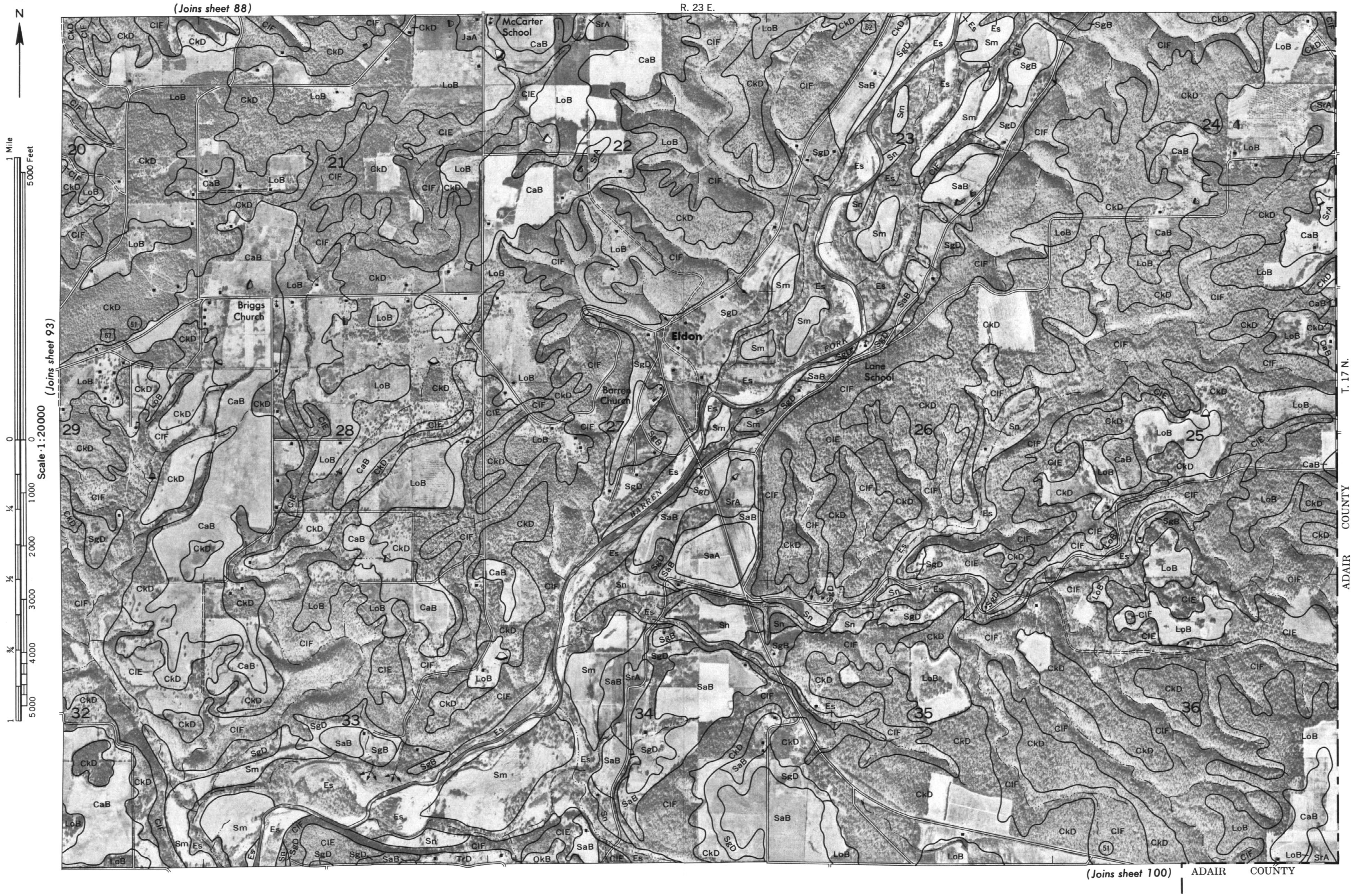
Land division corners are approximately positioned on this map.

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 93

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 94



CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 94

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

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Land division corners are approximately positioned on this map.

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 95

N

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 96

(Joins sheet 90)

(Joins sheet 102)

1 Mile | 5000 Feet

0 | 0

¼ | 1000 | 2000

½ | 3000

¾ | 4000

1 | 5000

Scale 1:20000

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 96

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

R. 21 E.

(Joins sheet 91)

(Joins sheet 96)

(Joins sheet 98)

(Joins sheet 103)

N

Scale 1:20000

1 Mile

5000 Feet

0 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 97

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA — SHEET NUMBER 98

N

(Joins sheet 92) R. 21 E. | R. 22 E.

(Joins sheet 97)

T. 16 N.

(Joins sheet 99)

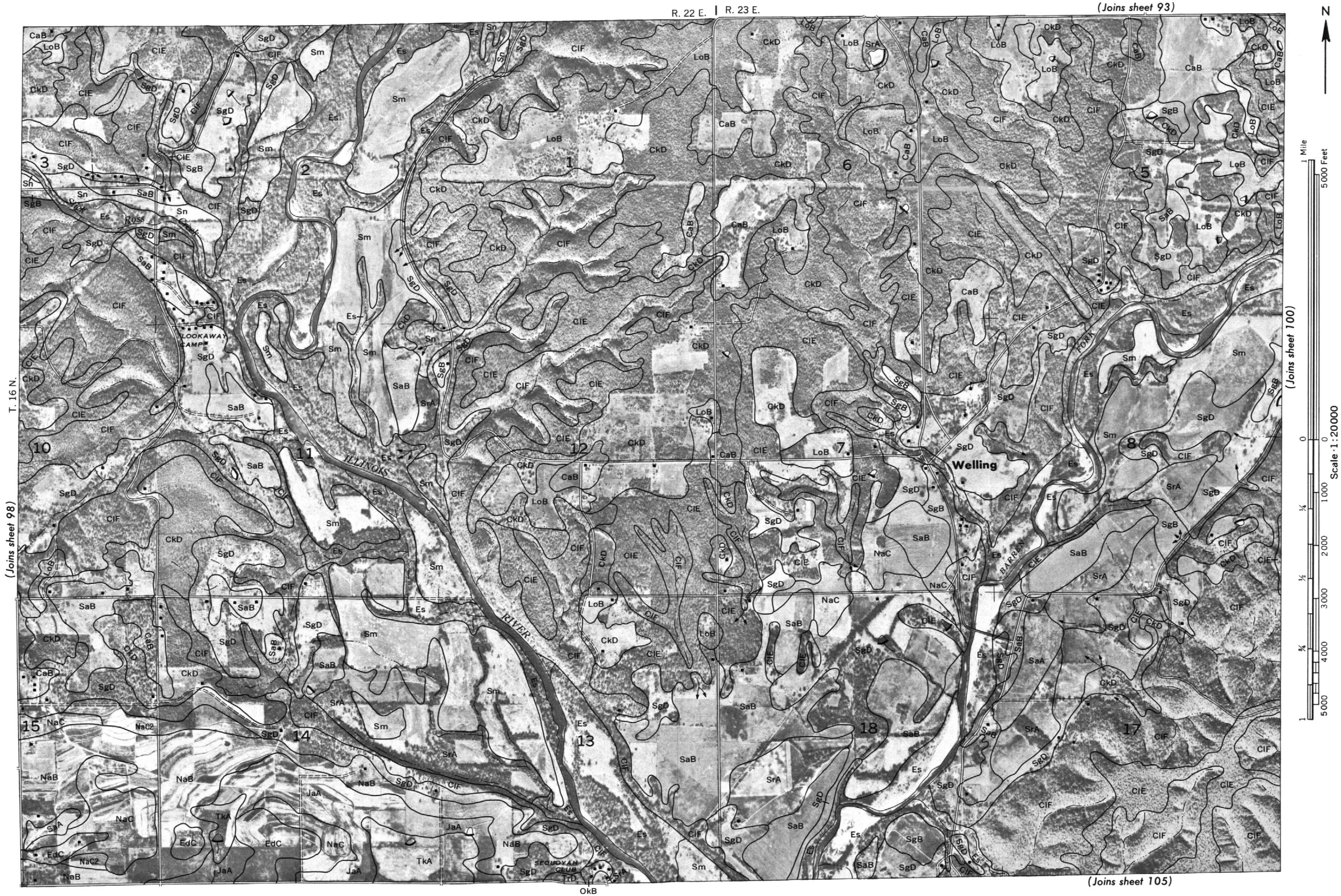
(Joins sheet 104)

1 Mile
5000 Feet
Scale 1:20000
0 1000 2000 3000 4000 5000
0 ¼ ½ ¾ 1

CHEROKEE AND DELAWARE COUNTIES, OKLAHOMA NO. 98

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.



This map is one of a set compiled in 1969 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Land division corners are approximately positioned on this map.